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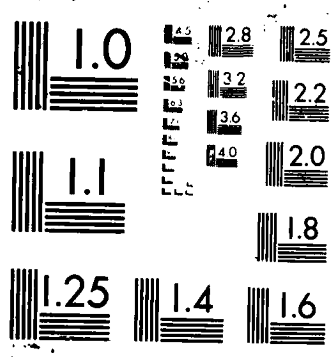
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CRC Report No. 554

AD-A188 330

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1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM USING GASOLINE-ALCOHOL BLENDS

August 1987

COORDINATING RESEARCH COUNCIL, INC.
219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

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1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM USING GASOLINE-ALCOHOL BLENDS

(CRC PROJECT No. CM-118-84)

Prepared by the

Analysis Panel for the

1984 CRC Intermediate Temperature Driveability Program

of the

CRC Volatility Group

August 1987

Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

ABSTRACT

Thirty 1984 and six 1979 model-year vehicles were tested with two hydrocarbon-only fuels and twenty hydrocarbon-alcohol blends during October and November 1984 at Paso Robles, California, to identify the effect of alcohol type, alcohol concentration, cosolvent type and methanol to cosolvent ratio on cold-start and warmup driveability at intermediate temperature (40°F-60°F). The secondary objective of the program was to determine if the 10, 50, and 90 percent distillation temperatures of these test fuels could predict cold-start and warmup driveability performance. In general, the hydrocarbon-only fuels gave better driveability than the hydrocarbon-alcohol blends; however, the 1984 model vehicles had better driveability on all fuels than earlier programs had exhibited. Fuel-injected vehicles gave better driveability than carburetted vehicles with all fuels. Increased volatility improved driveability with both hydrocarbon-only fuels and hydrocarbon-alcohol blends. Gasoline-ethanol blends gave better driveability than gasoline-methanol (without a cosolvent) blends. No significant differences were observed when ethanol and gasoline-grade tertiary butyl alcohol were compared as cosolvents in methanol blends.

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APPENDICES

I. INTRODUCTION

Interest in the use of oxygenates in gasoline has increased during recent years due to their economic and octane benefits. Past Coordinating Research Council (CRC) programs reported cold-start and warmup driveability performance on hydrocarbon fuels.[1-4] All of these programs reported driveability performance on the basis of 10, 50, and 90 percent distillation temperatures. The specific equations obtained from each of these programs were based upon the testing of all hydrocarbon fuels and did not consider the effects of fuels which contain alcohols. A program was conducted, therefore, from October 15 through November 16, 1984, at Paso Robles, California, to identify the effects of alcohol type, alcohol concentration, cosolvent type, and cosolvent ratio on cold-start and warmup driveability at intermediate ambient temperatures of 40°F to 60°F. A secondary objective was to determine if the 10, 50, and 90 percent distillation temperatures with the appropriate coefficients would also predict cold-start and warmup driveability performance with hydrocarbon-alcohol blends; if not, a second program would be required to develop equations using other volatility parameters.

Members of the Data Analysis and Report-Writing Panel are listed in Appendix A, and participants in the test program in Appendix B. The program proposal approved by the CRC Volatility Group is shown in Appendix C.

II. SUMMARY AND CONCLUSIONS

Cold-start driveability was measured at intermediate ambient temperatures (nominally 40°F to 60°F). The effects of alcohol type, alcohol concentration, cosolvent type, and cosolvent ratio were studied using three subprograms of twelve vehicles each. Each subprogram included vehicles equipped with carburetion and fuel-injection systems, and open- and closed-loop emission control systems. Driveability demerits were obtained for low and medium volatility hydrocarbon-only fuels and for hydrocarbon-alcohol blends. The hydrocarbon-alcohol blends matched Reid vapor pressure (RVP) levels of the comparative hydrocarbon-only fuels. The distillation curves or other fuel parameters were not matched between the hydrocarbon-only fuels and hydrocarbon-alcohol blends.

The major conclusions of the program are as follows:

- Based upon the twelve-vehicle average demerit levels in each subprogram, hydrocarbon-only fuels gave significantly better driveability than the hydrocarbon-alcohol blends at a constant RVP.

- On average, the 1984 model vehicles had better driveability on all fuels than earlier programs had exhibited with equivalent volatility hydrocarbon-only fuels.

- Increasing volatility improves driveability at constant oxygen concentrations of 0, 3.5, and 7.0 percent by weight oxygen.

- Driveability demerits appear to increase linearly up to 7.0 percent by weight oxygen at a constant RVP.

- Gasoline-ethanol blends gave significantly better driveability than gasoline-methanol (without a cosolvent) blends at 3.5 and 7.0 percent by weight oxygen at a constant RVP.

- When ethanol and gasoline-grade tertiary butyl alcohol (GTBA) were compared as cosolvents in methanol blends, there were no significant differences in driveability at 3.5 percent by weight oxygen with fuels of matched RVP and percent evaporated at 158°F.

- Methanol to cosolvent ratios of 1:1 and 4:1 with either ethanol or GTBA showed no significant differences in driveability at 3.5 percent by weight oxygen with fuels of matched RVP and percent evaporated at 158°F.

- Methanol to GTBA ratios of 1:1 and 4:1 showed no significant difference in driveability at 7.0 percent by weight oxygen with fuels of matched RVP and percent evaporated at 158°F.

- Fuel-injected vehicles gave significantly better driveability than carburetted vehicles with both hydrocarbon-only and hydrocarbon-alcohol blends.

- In general, open- and closed-loop vehicles showed similar increases in driveability demerits with increasing percent by weight oxygen.

- Driveability index equations developed on the hydrocarbon-only fuels used in this program underestimate demerits on hydrocarbon-alcohol blends, and therefore cannot be used to compare driveability performance of hydrocarbon-only fuels and hydrocarbon-alcohol blends.

III. TEST DESIGN

The fuel variables evaluated in this program were oxygen concentration, alcohol type, methanol to cosolvent ratio, cosolvent type, and volatility level. A study of these variables would require the testing of twenty-two fuels which, if evaluated in a single test vehicle fleet, would require a program of much longer duration than one month. Therefore, in order to obtain performance data on all of the fuel variables listed above, the program was designed to use three subprograms of twelve vehicles each. Each subprogram contained identical vehicles matched according to engine size and fuel delivery system. Each subprogram also evaluated the same two hydrocarbon-only fuels of low and medium volatility. Subprogram A tested the effects of oxygen concentration (0, 3.5, and 7.0 percent by weight) and alcohol type (methanol or ethanol) with no cosolvent. Subprogram B tested the effects of methanol to cosolvent ratio (1:1 and 4:1) using gasoline-grade tertiary butyl alcohol (GTBA) at three oxygen concentrations (0, 3.5, and 7.0 percent by weight). Subprogram C tested the effects of cosolvent type (ethanol or GTBA) and cosolvent ratio (1:1 and 4:1) on hydrocarbon-methanol-cosolvent blends.

In order to minimize daily ambient temperature variations, evaluations of all vehicles within each subprogram were completed before starting the next subprogram. The daily order for testing vehicles within each subprogram was on a random basis. The daily order for testing subprograms was the same each day; Subprogram B first, then Subprogram C, and Subprogram A last. Subprogram A was selected to run last due to higher ambient temperatures experienced late in the day which aided in the solubility of the high concentration of methanol present in Fuels 5 and 6.

Target ambient conditions for this test were 40°F to 60°F. Several days throughout the program, testing had to be delayed in the early morning due to low ambient temperature or rain. Of the 756 total runs, 117 were below the minimum target temperature of 40°, and 4 were above the maximum of 60°F.

IV. TEST TECHNIQUE

During this program, fuels were evaluated using the CRC Cold-Start and Warmup Driveability Procedure. The driving procedure was started by draining fuel tanks, adding test fuel, and performing a ten-mile warmup at 55 miles per hour on local roads. Next, the performance of each vehicle was evaluated on a fully warmed-up basis using the last

three cycles of the cold-start and warmup test procedure. The vehicle was then parked adjacent to the test course and allowed to soak at overnight ambient temperatures. The vehicle was driven the next day on a driving cycle which prescribes a cold start and a series of maneuvers consisting of engine idles, various types of accelerations, constant speed cruise, and decelerations. The complete driving procedure is described in Appendix C.

V. TEST FACILITIES

The program was conducted at Camp Roberts, a National Guard base located in Paso Robles, California. The facilities included a small office, a parking area for the test vehicles, and the test track. A schematic of the test track is shown in Figure 1. The course was laid out in the south garrison of Camp Roberts. Road markers were posted at one-tenth mile intervals for use by the drivers as references for beginning and ending driving maneuvers. Traffic was limited on the test course in order to minimize outside vehicular interference to the test vehicles.

VI. TEST VEHICLES

The vehicle fleet, described in Table I, consisted of thirty 1984 and six 1979 model-year vehicles calibrated to meet California emission standards. All vehicles were passenger cars, with the exception of three minivans, and all vehicles were equipped with automatic transmissions and air conditioners. The vehicles were divided into three test groups of twelve vehicles each to provide matched engine models and fuel delivery systems in each subprogram. The vehicles were chosen to provide a variety of fuel-delivery systems. These systems included both open- and closed-loop fuel control systems with carburetors, and closed-loop multipoint (MPI) and throttle-body (TBI) fuel-injection.

A Paso Robles car dealership installed fuel tank drains on the 1984 vehicles. The emission and fuel systems were not checked. The six 1979 vehicles were supplied and prepared by a participating company. The fuel tank drain hoses were installed on each vehicle on-site by the participants. At the completion of the program, the vehicles were returned to the dealer for removal of the tank drains.

VII. TEST FUELS

The test fuels are identified in Table II. Distillation curves are presented in Figures 2-7. The volatility levels of the hydrocarbon-only fuels were chosen to give a low volatility fuel (nominally, a Reid vapor pressure [RVP] of 9 psi and generally high distillation temperatures) and a medium volatility fuel (nominally, an RVP of 11 psi and generally intermediate distillation temperatures) compared with fuels which might be available in 40°-60°F use. The composition of the fuels containing alcohols was adjusted to give RVP matching the hydrocarbon-only fuels. This adjustment procedure required eliminating some quantity of butane from the alcohol-containing blend. The average test fuel properties are shown in Table III. Fuel property data from individual laboratories are shown in Appendix D. The $T_{V/L=20}$ data were determined by the ASTM D 2533 method modified to use mercury rather than glycerin. The analysis of alcohol concentration in these fuels was highly variable since each laboratory used a different analytical procedure. $T_{V/L}$ data at 5, 10, 15, and 20 V/L ratios, as analyzed by the supplier, are included in Table III.

VIII. DISCUSSION OF RESULTS

The average demerits for all test fuels in each subprogram are shown in Table IV. Differences in average demerits associated with oxygenate use are shown in Table V. Demerits are calculated for the twelve vehicle average within each subprogram and by the following classifications; open-loop, closed-loop, carburetted, and fuel-injected vehicles. Specific results for each fuel/vehicle combination are shown in Appendix E. In the following sections, use of the word "significant" indicates statistical significance at the 90 percent confidence level.

A. Results of Subprogram A

1. All Vehicle Effects

Subprogram A fuels were designed to show the effect of oxygen concentration (0, 3.5, and 7.0 percent by weight) and alcohol type (methanol and ethanol), at two volatility levels. Table V and Figure 8 show these effects based upon the average performance of twelve vehicles. A comparison of the two hydrocarbon-only fuels showed the low volatility hydrocarbon-only fuel to be significantly different at the

90 percent satisfaction level than the medium volatility hydrocarbon-only fuel. Table V and Figure 8 also illustrate the relationship of increasing TWD's with increasing oxygen concentration. Both methanol and ethanol at 3.5 and 7.0 percent by weight oxygen produced statistically significant increases in TWD's over the hydrocarbon-only fuels at both volatilities.

Within both the low and medium volatility fuel series, the difference in TWD's between methanol and ethanol at 3.5 and 7.0 percent by weight oxygen was statistically significant; however, this significance at the medium volatility level and 3.5 percent by weight oxygen was heavily influenced by one vehicle. Exclusion of the results from this vehicle would cause the difference between the ethanol- and methanol-containing fuels to be not significant. At both oxygen concentrations, methanol produced approximately double the increase in TWD's than ethanol.

2. Open-Loop Versus Closed-Loop Systems

Subprogram A fuels were tested with seven closed-loop fuel-metering systems and five conventionally carburetted non-feedback (open-loop) systems. These results are shown in Tables IV and V and Figure 9. There was essentially no difference in driveability between the two systems when comparing the hydrocarbon-only fuels at both volatility levels. The addition of methanol or ethanol, at the 3.5 percent by weight oxygen concentration, to either system generally caused a significant increase in demerits compared to the hydrocarbon-only fuels. Increasing the oxygen concentration to 7.0 percent oxygen by weight caused a significant increase in demerits compared to the 3.5 percent by weight oxygen fuels. Both systems are about twice as sensitive to the addition of methanol compared to ethanol at matched RVP.

3. Carburetted Versus Fuel-Injection Systems

Subprogram A fuels were tested using nine carburetted vehicles and three fuel-injected vehicles (two throttle-body and one port-injected). With every hydrocarbon-only and hydrocarbon-alcohol blend, the fuel-injected vehicles in Subprogram A had better driveability than the carburetted vehicles, as shown in Table V and Figure 10. The addition of methanol or ethanol to the hydrocarbon-only fuels at either 3.5 or 7.0 percent by weight oxygen did not cause a significant increase in TWD for fuel-injected vehicles. Carburetted vehicles, however, were more sensitive to alcohol use and, in general, showed a significant increase in demerits upon the addition of methanol or ethanol at matched RVP.

The carburetted vehicles experienced significant increases in TWD's at 3.5 percent by weight oxygen with methanol at both volatility levels, and with ethanol at the medium volatility level, compared to the hydrocarbon-only fuels. However, at the low volatility level with ethanol at 3.5 percent by weight oxygen, the demerits were not significantly different from the hydrocarbon-only fuels. At 7.0 percent by weight oxygen, the increases were significant with both alcohols. Methanol increased TWD's approximately twice as much as ethanol.

B. Results of Subprogram B

1. All Vehicle Effects

Subprogram B was designed to evaluate the effects of oxygen concentration (0, 3.5, and 7.0 percent by weight) and methanol to GTBA cosolvent ratio (1:1 and 4:1) at two volatility levels. Figure 11 plots the average demerits for the twelve vehicles in Subprogram B as a function of oxygen concentration for both the low and medium volatility fuels. Table V shows the differences in total weighted demerits associated with methanol:GTBA use in the low and medium volatility hydrocarbon-only gasoline. Consistent with Subprogram A vehicles, Subprogram B vehicles show that the lower volatility hydrocarbon-only fuels and hydrocarbon-alcohol blends had poorer driveability performance, as measured by a higher level of demerits, than the corresponding medium volatility fuels. As in Subprogram A, driveability demerits appear to increase linearly with increasing oxygen concentration. In addition, Figure 11 and Table V show that at equivalent oxygen concentration and volatility levels, there was no difference in driveability between fuels with methanol to GTBA ratios of either 1:1 or 4:1. Thus, the methanol to GTBA ratio does not affect driveability performance.

2. Open-Loop Versus Closed-Loop Systems

The performance of the seven vehicles with closed-loop feedback systems are compared with the five open-loop vehicles in Tables IV and V and Figure 12. With the hydrocarbon-only fuels, the closed-loop vehicles performed significantly better than open-loop vehicles. With hydrocarbon-alcohol blends, both the open- and closed-loop vehicles had higher TWD's than with the hydrocarbon-only fuel. These increases were greater with the open-loop vehicles. In most cases, there was little difference in TWD's with fuels having a methanol to cosolvent ratio of 1:1 and 4:1, indicating that methanol to cosolvent ratio does not affect driveability performance.

3. Carburetion Versus Fuel-Injection Systems

The three fuel-injected vehicles had much better driveability than the nine carburetted vehicles on both the hydrocarbon-only fuels and hydrocarbon-alcohol blends in Subprogram B, as shown in Tables IV and V and Figure 13. Tests with the medium volatility fuels showed oxygen concentration and methanol to cosolvent ratio have no effect on the performance of fuel-injected vehicles at either 3.5 or 7.0 percent by weight oxygen concentrations. Also, no performance differences were noted with methanol to cosolvent ratios of 1:1 and 4:1. The carburetted vehicles did experience increased TWD's with oxygen concentration, but changing the methanol to cosolvent ratio had no affect on driveability performance.

With the low volatility fuels, the fuel-injected vehicles experienced an increase in TWD's at the 3.5 percent by weight oxygen concentration, and no further increase in TWD's at the 7.0 percent by weight oxygen concentration. The carburetted vehicles had large TWD increases at both the 3.5 and 7.0 percent by weight oxygen concentrations. Both carburetted and fuel-injected vehicles had equivalent driveability performance with 1:1 and 4:1 methanol to cosolvent ratio.

C. Results of Subprogram C

1. All Vehicle Effects

Subprogram C was designed to show the effect of cosolvent type (GTBA and ethanol) and methanol to cosolvent ratio (1:1 and 4:1) at 3.5 percent by weight oxygen in two volatility levels. The driveability data for all vehicles are presented in Tables IV and V and Figure 14.

Evaluations of the hydrocarbon-only fuels and the hydrocarbon-alcohol blends showed again that the medium volatility fuel provided better driveability than the low volatility fuel. Additionally, all the hydrocarbon-alcohol blends gave higher TWD's than hydrocarbon-only fuels with similar RVP. No difference in driveability was noted among any of the hydrocarbon-alcohol blends when ethanol or GTBA were used as cosolvents at methanol to cosolvent ratios of 1:1 and 4:1.

2. Open-Loop Versus Closed-Loop Vehicles

Comparisons of performance between open- and closed-loop vehicles are shown in Tables IV and V and Figure 15. Fuel system type (open-loop or closed-loop) did not affect driveability performance with either hydrocarbon-only fuels or hydrocarbon-alcohol blends. Neither cosolvent type or cosolvent ratio had a significant effect on vehicle performance.

3. Carburetion Versus Fuel-Injection Systems

The fuel-injected vehicles had much lower TWD's than the carburetted vehicles at both volatility levels with both the hydrocarbon-only fuels and the hydrocarbon-alcohol blends. Data for the carburetted and fuel-injected vehicles are given in Tables IV and V and Figure 16.

The fuel-injected vehicles tested on the medium volatility hydrocarbon-alcohol blends did not show an increase in TWD's when compared to the hydrocarbon-only fuel. The carburetted vehicles tested on the medium volatility fuel gave much higher TWD's, but showed no effect of cosolvent type or cosolvent ratio.

The fuel-injected vehicles, when tested on the low volatility hydrocarbon-alcohol blends, gave significantly higher TWD's with the 4:1 methanol to cosolvent ratio blends from the hydrocarbon-only fuels. The 1:1 methanol to cosolvent ratio fuels did not significantly affect vehicle performance. The carburetted vehicles showed a significant increase in TWD's with the hydrocarbon-alcohol blends; however, there was no significant difference in performance with cosolvent type or cosolvent ratio.

D. Comparison of Subprograms: Type of Severity Levels

Each subprogram contained vehicles matched according to engine type and fuel delivery system. Also, each subprogram tested the low and medium volatility hydrocarbon-only fuels. The performance data from these two fuels can provide information on the severity levels of the various subprograms and vehicle types.

A comparison of performance levels of the three subprograms (twelve vehicles each) are shown in Figure 17. Subprogram B is the most severe when tested with the low volatility fuel and significantly different from Subprograms A and C. Subprogram A is the least severe when tested with the medium volatility fuel and is significantly different from Subprograms B and C.

A comparison of the average demerit levels for the twelve sets of three matched vehicles when tested with the two hydrocarbon-only fuels is shown in Figure 18. In general, the fuel-injected vehicles and the closed-loop carburetted vehicles have fewer demerits than the open-loop vehicles. The vehicles in Sub-Group 11, Vehicle Numbers 11, 31, and 51, Figure 18, tended to distort any comparisons of open-loop versus closed-loop carburetted vehicles. Individual vehicles, when tested on the two hydrocarbon-only fuels, ranged from 5 to 229 TWD's. Similar tests on the medium volatility fuel gave a range of 0 to 159 demerits.

The above variations in TWD's with hydrocarbon-only fuels are also noted when vehicles are tested with hydrocarbon-alcohol blends. The twelve vehicles in Subprogram B were tested with a methanol to GTBA ratio of 1:1 in gasoline at two oxygen concentrations with the low volatility fuel. The average response of these vehicles with oxygen concentration is shown in Figure 19. It also includes the performance level of the most and least severe vehicles. Similar ranges in performance levels with oxygen concentration occur with vehicles in Subprograms A and C.

E. Classification by Test Maneuvers and Malfunctions

Appendix F presents the total demerit level and percent of demerits for each Subprogram by fuel. Demerits for each malfunction type are the twelve-vehicle sum of reported malfunctions by the raters. For any particular maneuver for which more than one malfunction was reported, all of the malfunctions are counted. For demerits by maneuver, only the highest-demerit malfunction is included in the tabulation.

There are variations in results for malfunction type and maneuver; however, some general observations can be made. Demerit levels increase with hydrocarbon-alcohol blends for hesitation, stumble, surge, and stalls, but the percent of malfunctions are relatively constant. Idle and starting demerits tend to be constant for hydrocarbon-only and hydrocarbon-alcohol blends; therefore, the percent of idle and starting demerits are a lower percentage of the total demerits for hydrocarbon-alcohol blends.

F. Prediction of Driveability Demerits

To determine if TWD's can be predicted with the CRC Driveability Equation developed using 1973 model-year vehicles[1], predicted TWD's were calculated for all twenty-two test fuels.* These predicted TWD's are compared with the average TWD's determined during this program in Figures 20, 21, and 22. The hydrocarbon-only fuels gave substantially fewer demerits than predicted, indicating that the 1984 vehicles performed better than the 1973 vehicles, and an updated equation should be developed that recognizes this fact. In addition, the current equation does not adequately predict the average TWD's for the hydrocarbon-alcohol blends, indicated by the difference in both slopes and intercepts for each group of fuels. The poorest performing hydrocarbon-alcohol blends approached, but did not exceed, the predicted values. Figures 20 and 21 show that increasing the oxygen concentration lowers the predicted demerits at equivalent RVP. Since increasing the oxygen concentration increases the number of actual TWD's, the model needs some adjustment for the addition of alcohol. It appears that the slope of the actual demerits closely matches the slope of the predicting equation; therefore, the adjustment for the addition of alcohols could be made with a change of the intercept. However, it is generally believed that the addition of another distillation parameter in the driveability equation could further improve the prediction with hydrocarbon-alcohol fuels.

G. Comparison with Results from Previous CRC Programs

To show trends in driveability level and the response of vehicles to changes in gasoline volatility, the results of this program with 1984 model-year vehicles were compared with similar data for 1973[1], 1975[2], 1977[3], and 1980[4] model-year vehicles. For the 1980 vehicles, only the intermediate temperature data were used.

Figure 23 shows average TWD versus fuel volatility (expressed in terms of $0.5T_{10} + T_{50} + 0.5T_{90}$) for each of the programs. With the exception of 1980 vehicles, driveability performance has progressively improved (lower TWD's) from 1973 through 1984 with hydrocarbon fuels.

Because the 1973 through 1980 model-year vehicles were mostly carburetted, Figure 23 shows both carburetted and fuel-injected data for the 1984 model-year vehicles. Even the 1984 carburetted-only vehicles performed better than the previous model-year vehicles; the 1984 fuel-injected vehicles performed much better than the 1984 carburetted vehicles.

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* The CRC Driveability Equation used to predict TWD's in this report is:

$$\text{Adjusted TWD} = -285.7 + 0.6166(T_{10}) + 0.8527(T_{50}) + 0.4706(T_{90})$$

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REFERENCES

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T A B L E S

AND

F I G U R E S

TABLE I

DESCRIPTION OF TEST VEHICLES

Make	Model	Eng.Displ. liters	Fuel System: Carburetted	Fuel System: Injected	Fuel Control System*: OL	Fuel Control System*: CL
Subprogram A						
Buick	Regal	3.8	X			X
Buick	Electra	3.8		MPI		X
Buick**	Century	2.8	X		X	
Buick	Skylark	2.5		TBI		X
Chevrolet**	Malibu	5.0	X		X	
Ford	Mustang	2.3	X			X
Mercury	Lynx	1.6	X		X	
Mercury	Capri	3.8		TBI		X
Dodge***	Caravan	2.6	X		X	
Dodge	Aries	2.2	X			X
Nissan	Sentra	1.6	X		X	
Toyota	Tercel	1.5	X			X
Subprogram B						
Buick	Regal	3.8	X			X
Buick	Electra	3.8		MPI		X
Buick**	Century	2.8	X		X	
Buick	Skylark	2.5		TBI		X
Chevrolet**	Malibu	5.0	X		X	
Ford	Mustang	2.3	X			X
Mercury	Lynx	1.6	X		X	
Ford	Mustang	3.8		TBI		X
Dodge***	Caravan	2.6	X		X	
Dodge	Aries	2.2	X			X
Nissan	Sentra	1.6	X		X	
Toyota	Tercel	1.5	X			X
Subprogram C						
Oldsmobile	Cutlass	3.8	X			X
Oldsmobile	98	3.8		MPI		X
Buick**	Century	2.8	X		X	
Chevrolet	Citation	2.5		TBI		X
Chevrolet**	Malibu	5.0	X		X	
Ford	Mustang	2.3	X			X
Mercury	Lynx	1.6	X		X	
Ford	Mustang	3.8		TBI		X
Dodge***	Caravan	2.6	X		X	
Plymouth	Reliant	2.2	X			X
Nissan	Sentra	1.6	X		X	
Toyota	Tercel	1.5	X			X

* OL = Open-Loop; CL = Closed-Loop
** 1979 Model Year
*** Designed to meet light-duty truck emissions standards.

TABLE II

TEST FUELS

Oxygenate	Cxygen Content wt %	CoSolvent Ratio	CoSolvent Type	Fuel Volatility	Fuel Blend Nos.
Subprogram A					
None	0.0	--	--	Low & Med.	1 & 2
Methanol	3.5	1:0	--	Low & Med.	3 & 4
Methanol	7.0	1:0	--	Low & Med.	5 & 6
Ethanol	3.5	1:0	--	Low & Med.	7 & 8
Ethanol	7.0	1:0	--	Low & Med.	9 & 10
Subprogram B					
None	0.0	--	--	Low & Med.	1 & 2
Meth/TBA	3.5	1:1	GTBA	Low & Med.	11 & 12
Meth/TBA	7.0	1:1	GTBA	Low & Med.	13 & 14
Meth/TBA	3.5	4:1	GTBA	Low & Med.	15 & 16
Meth/TBA	7.0	4:1	GTBA	Low & Med.	17 & 18
Subprogram C					
None	0.0	--	--	Low & Med.	1 & 2
Meth/TBA	3.5	1:1	GTBA	Low & Med.	11 & 12
Meth/TBA	3.5	4:1	GTBA	Low & Med.	15 & 16
Meth/Eth	3.5	1:1	Ethanol	Low & Med.	19 & 20
Meth/Eth	3.5	4:1	Ethanol	Low & Med.	21 & 22

TABLE III: AVERAGE TEST FUEL PROPERTIES

	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11
RVP, psi	8.6	10.7	8.8	10.9	8.8	10.9	9.1	11.1	8.6	10.9	8.8
D86 Distillation, °F											
% Evap											
IBP	82	82	103	94	106	95	91	90	97	91	98
5	113	102	119	112	121	111	114	107	119	110	118
10	135	121	125	116	127	117	134	121	136	125	128
20	174	151	138	125	134	126	147	139	151	142	145
30	206	182	199	161	137	134	158	149	158	153	179
40	228	204	228	201	210	200	204	162	162	158	213
50	249	220	249	218	243	214	243	206	174	161	242
60	270	232	271	231	264	228	264	231	246	187	265
70	294	248	295	248	291	244	290	244	281	234	291
80	318	272	318	272	316	271	316	269	309	261	316
90	341	317	338	318	340	318	338	316	334	304	339
95	374	356	372	352	373	354	371	355	365	350	368
EP	434	415	437	415	428	415	435	421	426	413	431
% 158	17.1	23	23	28	33	30	30	39	35	44	24
$T_{V/L=5}$, °F	137	118	123	114	127	118	129	118	130	119	132
$T_{V/L=10}$, °F	146	124	126	118	130	121	132	121	134	123	136
$T_{V/L=15}$, °F	152	129	128	120	132	123	134	125	137	127	138
$T_{V/L=20}$, °F	158	134	130	122	134	124	137	127	140	130	141
Gravity, API	55.9	64.4	53.7	61.7	53.4	61.2	55.1	62.4	54.4	60.8	54.2
FIA Analysis											
Saturates	61.9	77.4	--	--	--	--	--	--	--	--	--
Olefins	3.7	3.1	--	--	--	--	--	--	--	--	--
Aromatics	34.3	19.5	--	--	--	--	--	--	--	--	--
Alcohol Content, V%											
MeOH	--	--	6.4	5.2	10.6	9.0	--	--	--	--	4.8
GTBA	--	--	--	--	--	--	--	--	--	--	4.9
EtOH	--	--	--	--	--	--	8.8	9.3	17.4	18.0	--

TABLE III: AVERAGE TEST FUEL PROPERTIES - (CONTINUED)

	Fuel 12	Fuel 13	Fuel 14	Fuel 15	Fuel 16	Fuel 17	Fuel 18	Fuel 19	Fuel 20	Fuel 21	Fuel 22
RVP, psi	10.9	8.9	10.8	8.9	11.1	8.9	11.0	8.9	10.8	8.7	10.8
D86 Distillation, °F											
% Evap											
IBP	92	97	94	102	93	105	94	100	94	104	94
5	108	116	111	118	107	118	109	120	108	120	109
10	119	130	122	127	117	128	118	128	120	127	119
20	134	141	135	137	127	136	129	140	130	141	128
30	159	152	144	182	155	142	135	176	144	191	151
40	188	173	157	221	194	179	145	223	187	228	196
50	213	207	180	245	217	229	188	246	217	249	220
60	231	251	211	267	232	259	225	268	231	270	231
70	248	283	238	293	248	285	243	293	246	296	247
80	271	309	265	316	273	313	265	316	271	318	273
90	316	334	311	339	316	336	312	340	317	339	317
95	355	363	349	372	354	366	348	370	358	371	351
EP	417	427	412	432	421	426	417	431	424	433	422
% 158	30	34	41	25	31	34	44	26	34	25	31
$T_{V/L=5}$, °F	118	126	124	128	116	124	120	125	124	129	114
$T_{V/L=10}$, °F	122	129	128	131	118	127	122	128	126	132	116
$T_{V/L=15}$, °F	124	132	130	133	120	129	123	131	128	134	119
$T_{V/L=20}$, °F	126	140	132	135	122	130	125	133	130	135	121
Gravity, API	61.3	53.8	60.1	54.0	61.4	53.6	60.3	54.1	61.6	53.7	61.2
FIA Analysis											
Saturates	--	--	--	--	--	--	--	--	--	--	--
Olefins	--	--	--	--	--	--	--	--	--	--	--
Aromatics	--	--	--	--	--	--	--	--	--	--	--
Alcohol Content, V%											
MeOH	4.5	9.4	9.7	6.5	5.8	12.0	12.1	4.4	4.8	5.8	5.0
GTBA	4.9	9.8	10.3	2.3	1.9	3.4	3.4	--	--	--	--
EtOH	--	--	--	--	--	--	--	3.5	4.0	1.4	1.7

TABLE IV

AVERAGE TOTAL WEIGHTED DEMERIT (TWD) DATA BY SUBPROGRAM

Fuel No.	Vola-tility	Alcohol	% O_2	Co-Solvent	Ratio	Average Total Weighted Demerits (TWD): All Cars	Carb Cars	FI Cars	Closed Loop Cars	Open Loop Cars
Subprogram A										
1	Low	None	0	None	--	61	71	31	65	55
3		MeOH	3.5	None	--	87	101	45	90	82
5		MeOH	7.0	None	--	119	144	45	109	133
7		EtOH	3.5	None	--	74	85	42	79	66
9		EtOH	7.0	None	--	87	105	31	89	83
2	Medium	None	0	None	--	24	29	9	24	24
4		MeOH	3.5	None	--	41	52	9	45	36
6		MeOH	7.0	None	--	64	80	16	67	60
8		EtOH	3.5	None	--	35	43	10	37	32
10		EtOH	7.0	None	--	45	57	9	50	38
Subprogram B										
1	Low	None	0	None	--	74	87	36	59	95
11		MeOH	3.5	GTBA	1:1	105	119	63	105	104
13		MeOH	7.0	GTBA	1:1	128	152	57	110	152
15		MeOH	3.5	GTBA	4:1	101	114	63	91	115
17		MeOH	7.0	GTBA	4:1	128	150	62	98	171
2	Medium	None	0	None	--	44	52	26	34	58
12		MeOH	3.5	GTBA	1:1	61	72	30	48	80
14		MeOH	7.0	GTBA	1:1	75	92	24	52	95
16		MeOH	3.5	GTBA	4:1	64	77	26	45	91
18		MeOH	7.0	GTBA	4:1	65	78	26	46	92
Subprogram C										
1	Low	None	0	None	--	60	75	14	57	64
11		MeOH	3.5	GTBA	1:1	103	127	29	92	117
15		MeOH	3.5	GTBA	4:1	108	133	33	106	111
19		MeOH	3.5	EtOH	1:1	103	129	26	91	120
21		MeOH	3.5	EtOH	4:1	112	135	42	98	131
2	Medium	None	0	None	--	40	52	4	35	46
12		MeOH	3.5	GTBA	1:1	63	81	8	66	58
16		MeOH	3.5	GTBA	4:1	61	77	12	55	63
20		MeOH	3.5	EtOH	1:1	64	83	6	64	63
22		MeOH	3.5	EtOH	4:1	58	74	10	64	49

TABLE V

DIFFERENCE IN TOTAL WEIGHTED DEMERIT (TWD) DATA BY SUBPROGRAM

Fuel No.	Vola-tility	Alcohol	% O_2	Co-Solvent	Ratio	Difference in Total Weighted Demerits (TWD) From Hydrocarbon-Only Fuel: All Cars	Carb Cars	FI Cars	Closed Loop Cars	Open Loop Cars
Subprogram A										
3	Low	MeOH	3.5	None	--	26	30	14	25	27
5		MeOH	7.0	None	--	58	73	14	44	78
7		EtOH	3.5	None	--	13	14	11	14	11
9		EtOH	7.0	None	--	26	34	0	24	28
4	Medium	MeOH	3.5	None	--	17	23	0	21	12
6		MeOH	7.0	None	--	40	51	7	43	36
8		EtOH	3.5	None	--	11	14	1	13	8
10		EtOH	7.0	None	--	21	28	0	26	14
Subprogram B										
11	Low	MeOH	3.5	GTBA	1:1	31	32	27	46	9
13		MeOH	7.0	GTBA	1:1	54	65	21	51	57
15		MeOH	3.5	GTBA	4:1	27	27	27	32	20
17		MeOH	7.0	GTBA	4:1	54	63	21	39	76
12	Medium	MeOH	3.5	GTBA	1:1	17	20	9	14	22
14		MeOH	7.0	GTBA	1:1	31	40	3	18	37
16		MeOH	3.5	GTBA	4:1	20	25	5	11	33
18		MeOH	7.0	GTBA	4:1	21	26	5	12	34
Subprogram C										
11	Low	MeOH	3.5	GTBA	1:1	43	52	15	35	53
15		MeOH	3.5	GTBA	4:1	48	58	19	49	47
19		MeOH	3.5	EtOH	1:1	43	54	12	34	56
21		MeOH	3.5	EtOH	4:1	52	60	28	41	67
12	Medium	MeOH	3.5	GTBA	1:1	23	29	4	31	12
16		MeOH	3.5	GTBA	4:1	21	25	8	20	17
20		MeOH	3.5	EtOH	1:1	24	31	2	29	17
22		MeOH	3.5	EtOH	4:1	18	22	6	29	3

"__" Indicates demerits are not statistically different from hydrocarbon-only fuel demerits at the 90% confidence level.

Figure 1

CRC COLD START AND DRIVEAWAY COURSE

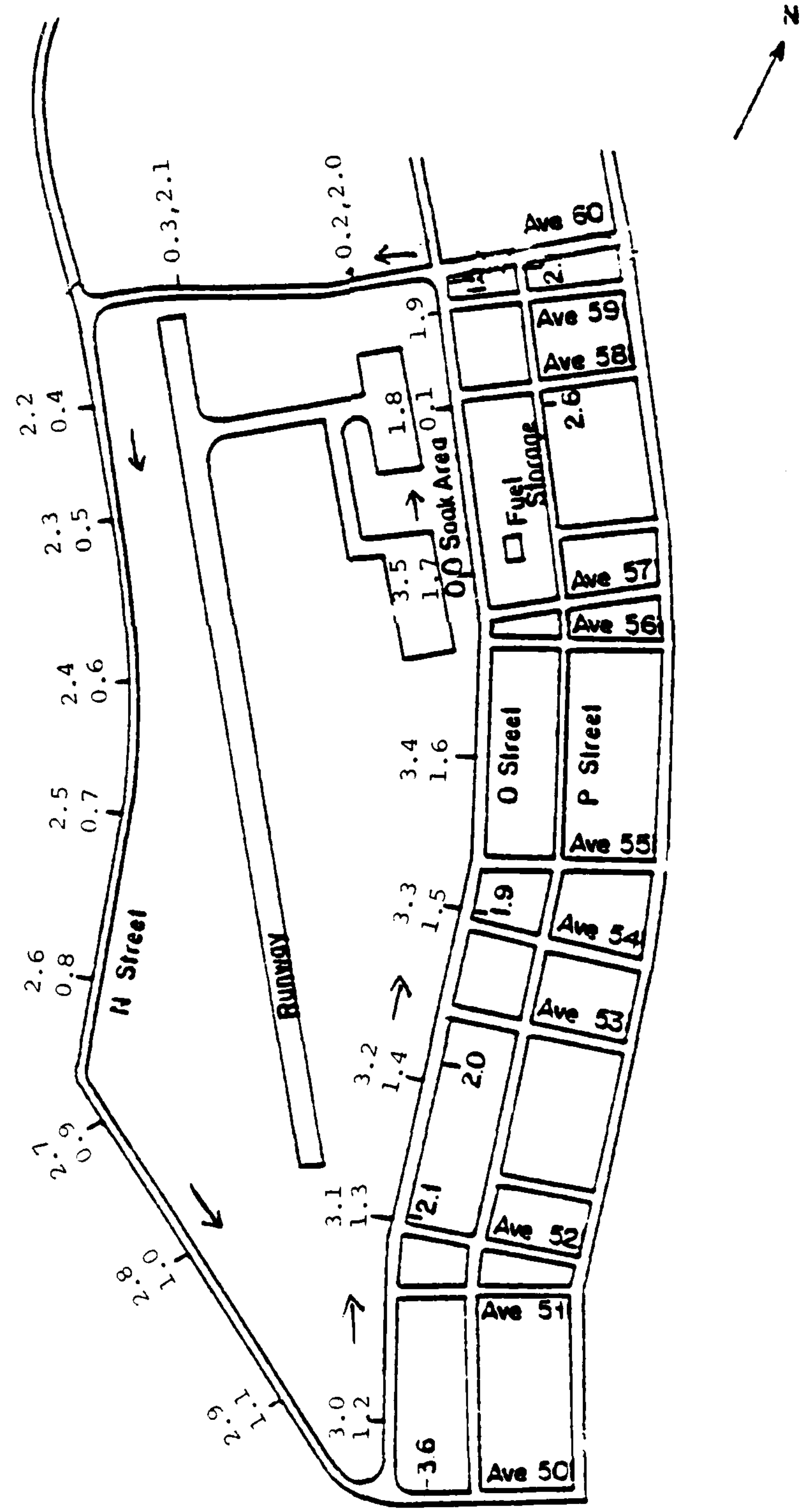


FIGURE 2

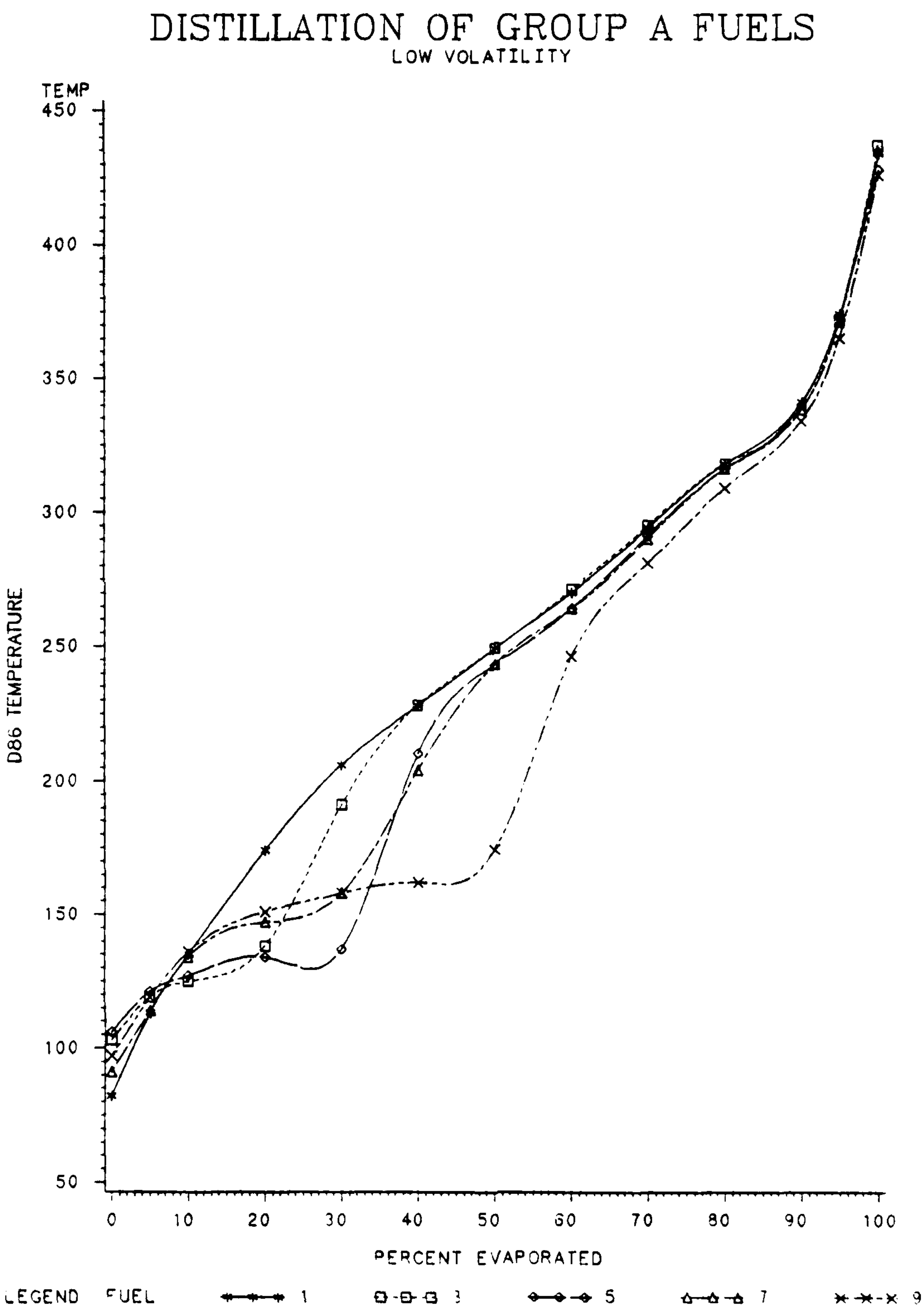

DISTILLATION OF GROUP A FUELS
LOW VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND FUEL
1
3
5
7
9

FIGURE 3

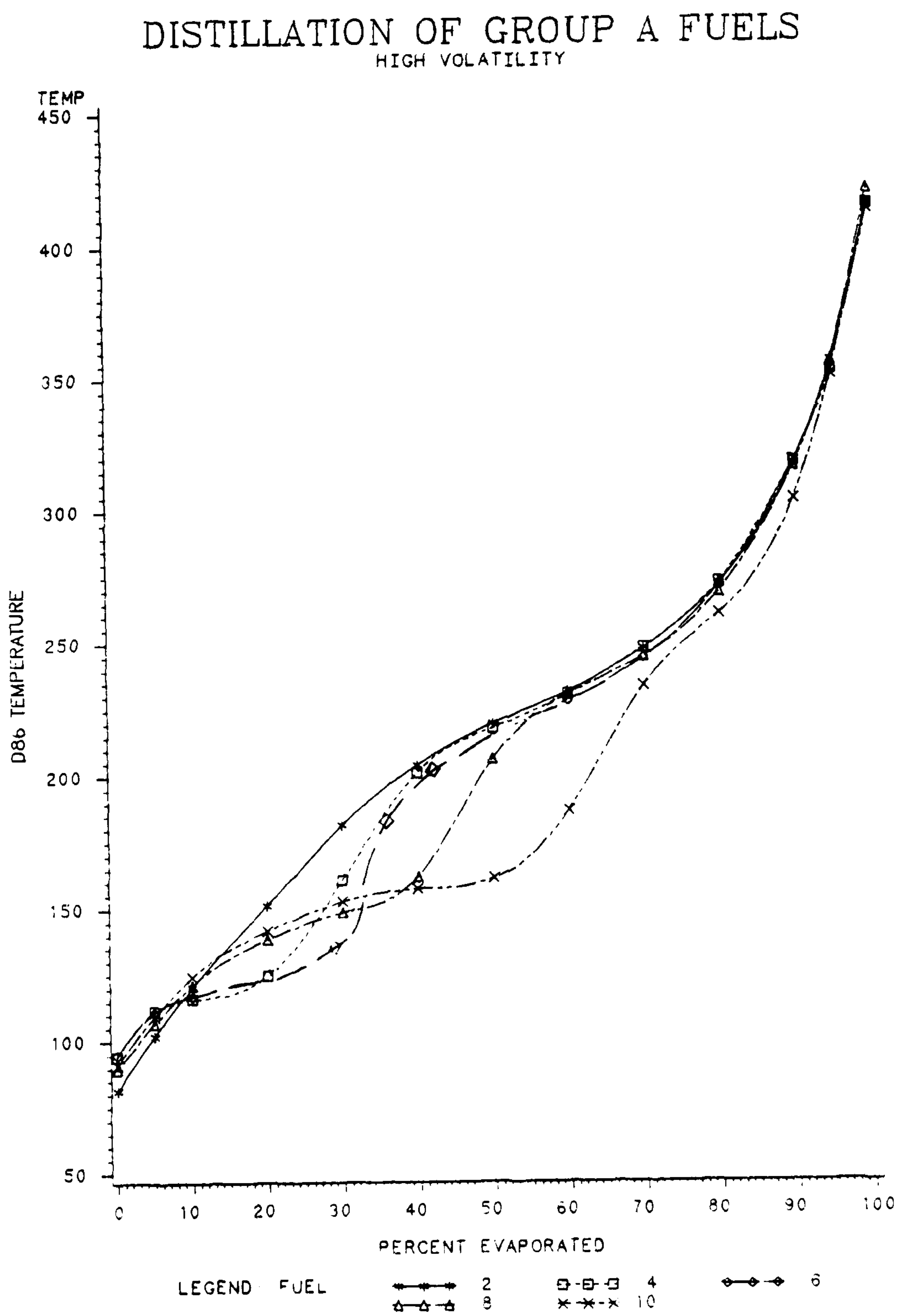
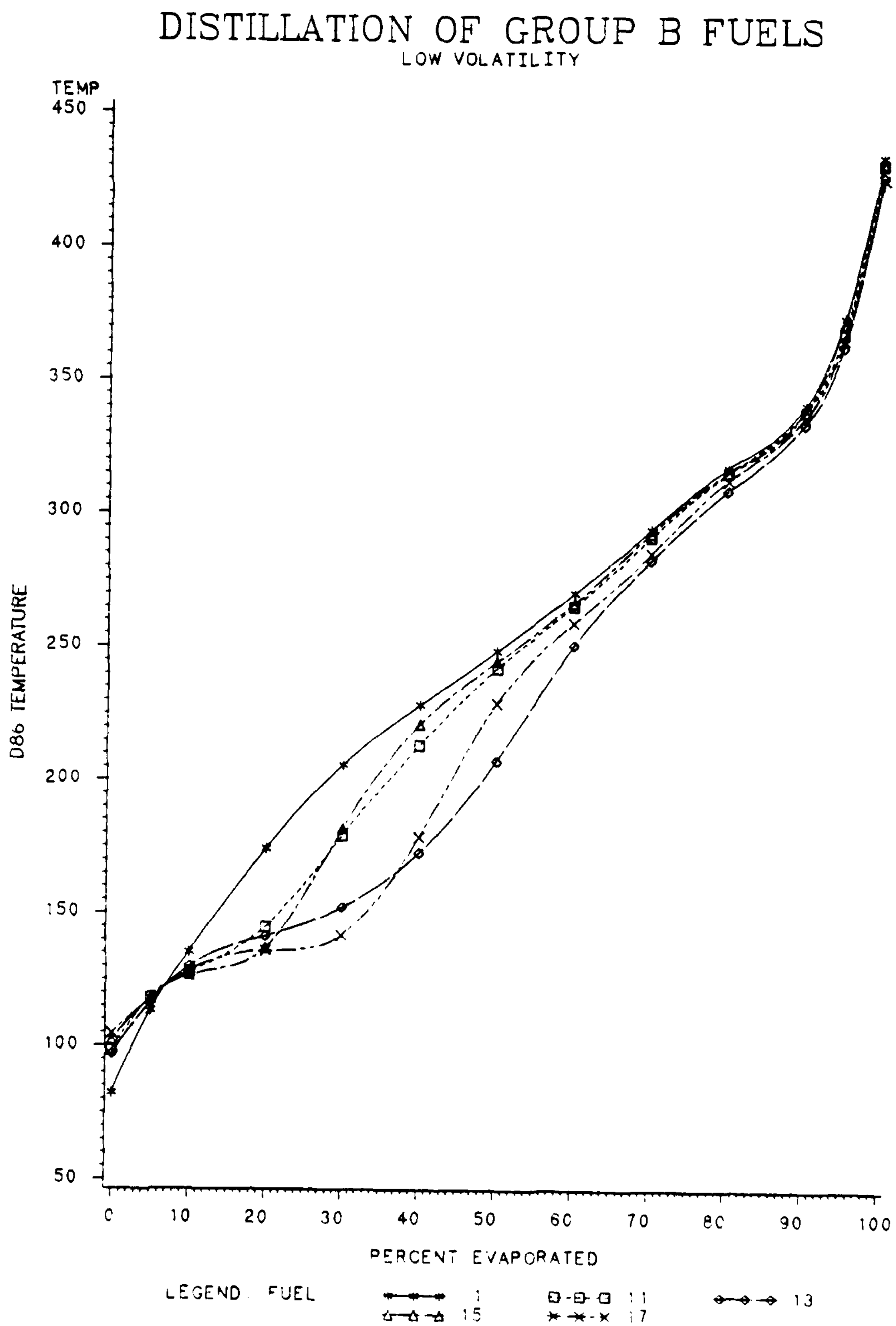

DISTILLATION OF GROUP A FUELS
HIGH VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND FUEL
2
4
6
8
10

FIGURE 4



DISTILLATION OF GROUP B FUELS
LOW VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND FUEL
1
11
13
15
17

FIGURE 5

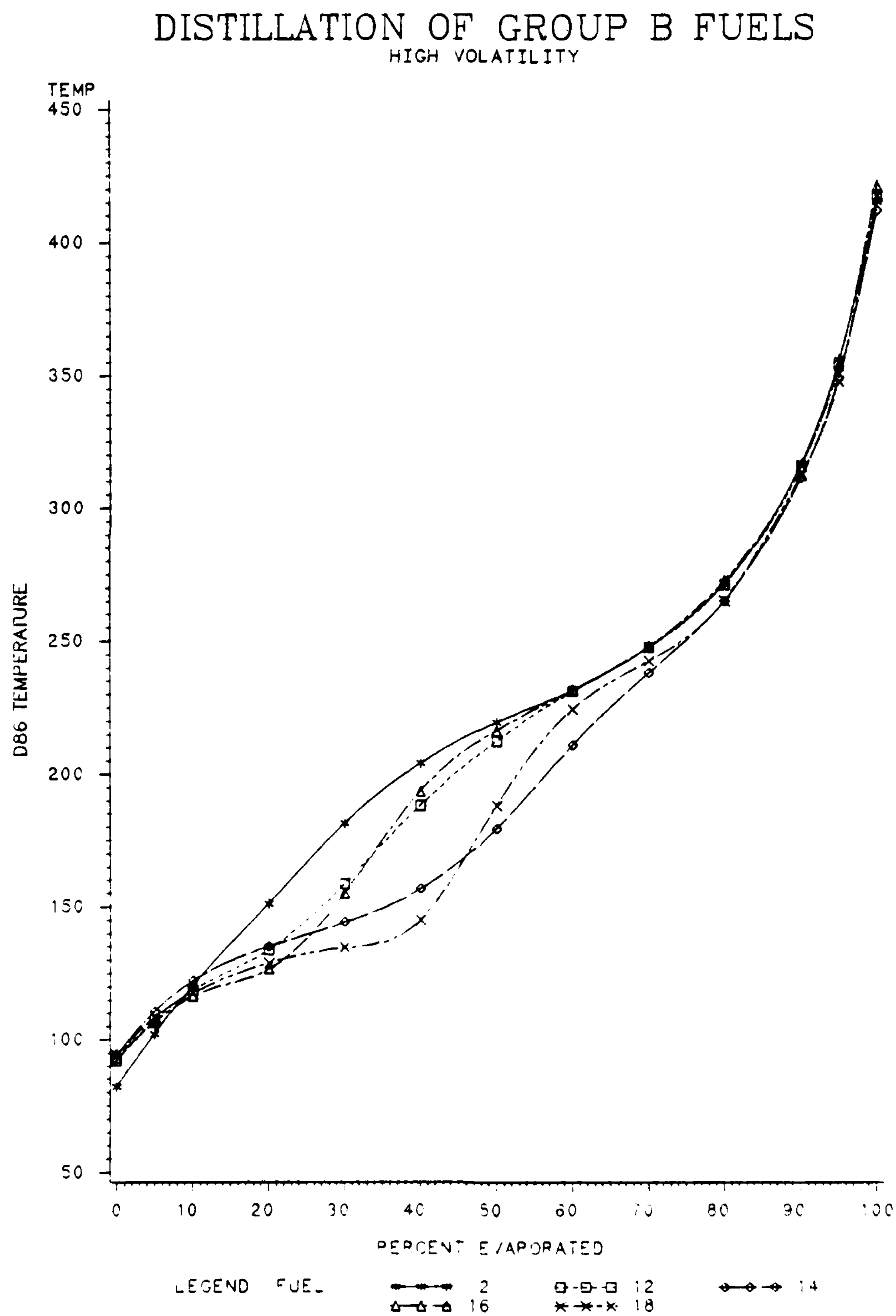

DISTILLATION OF GROUP B FUELS
HIGH VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND FUEL
2
12
14
16
18

FIGURE 6

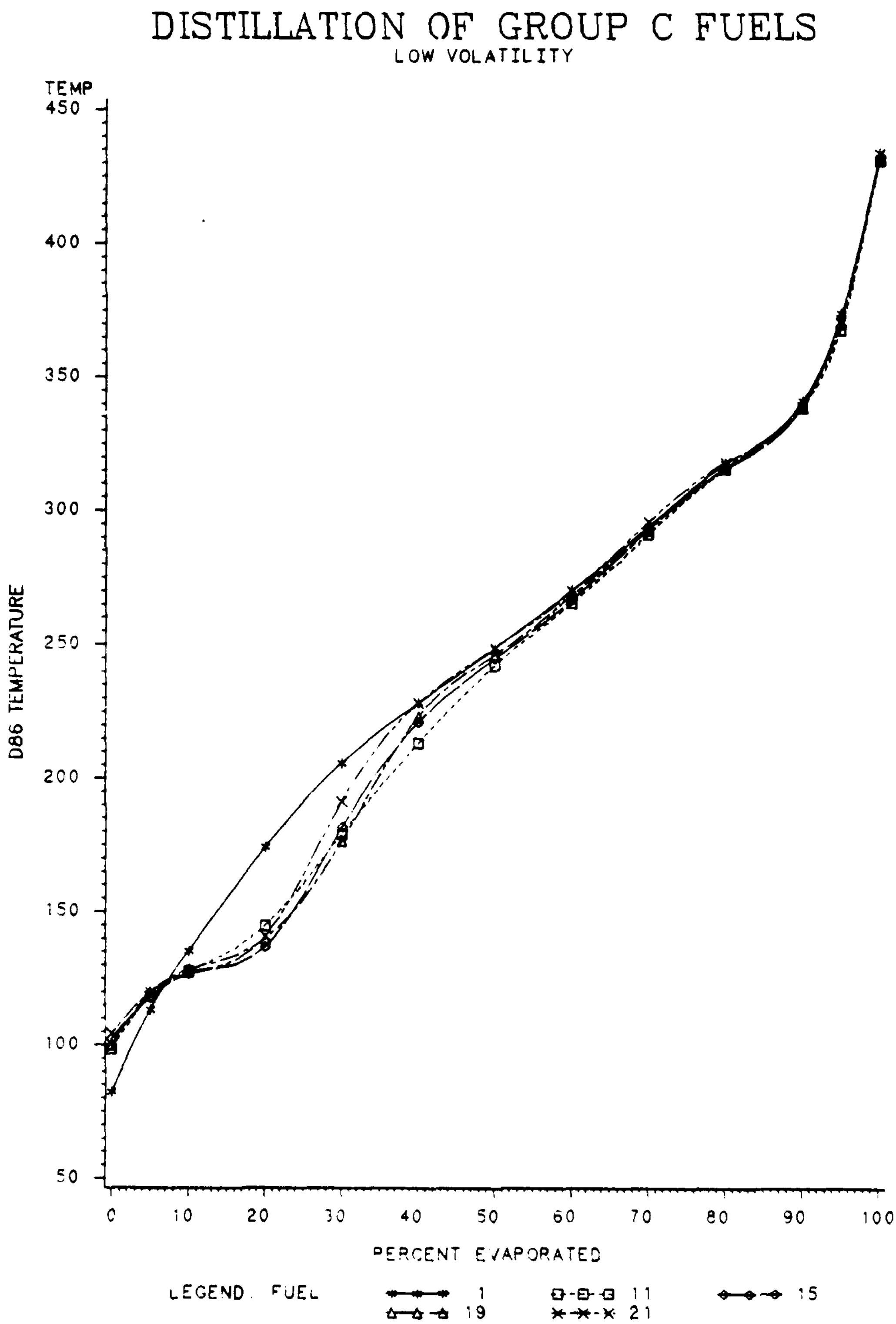
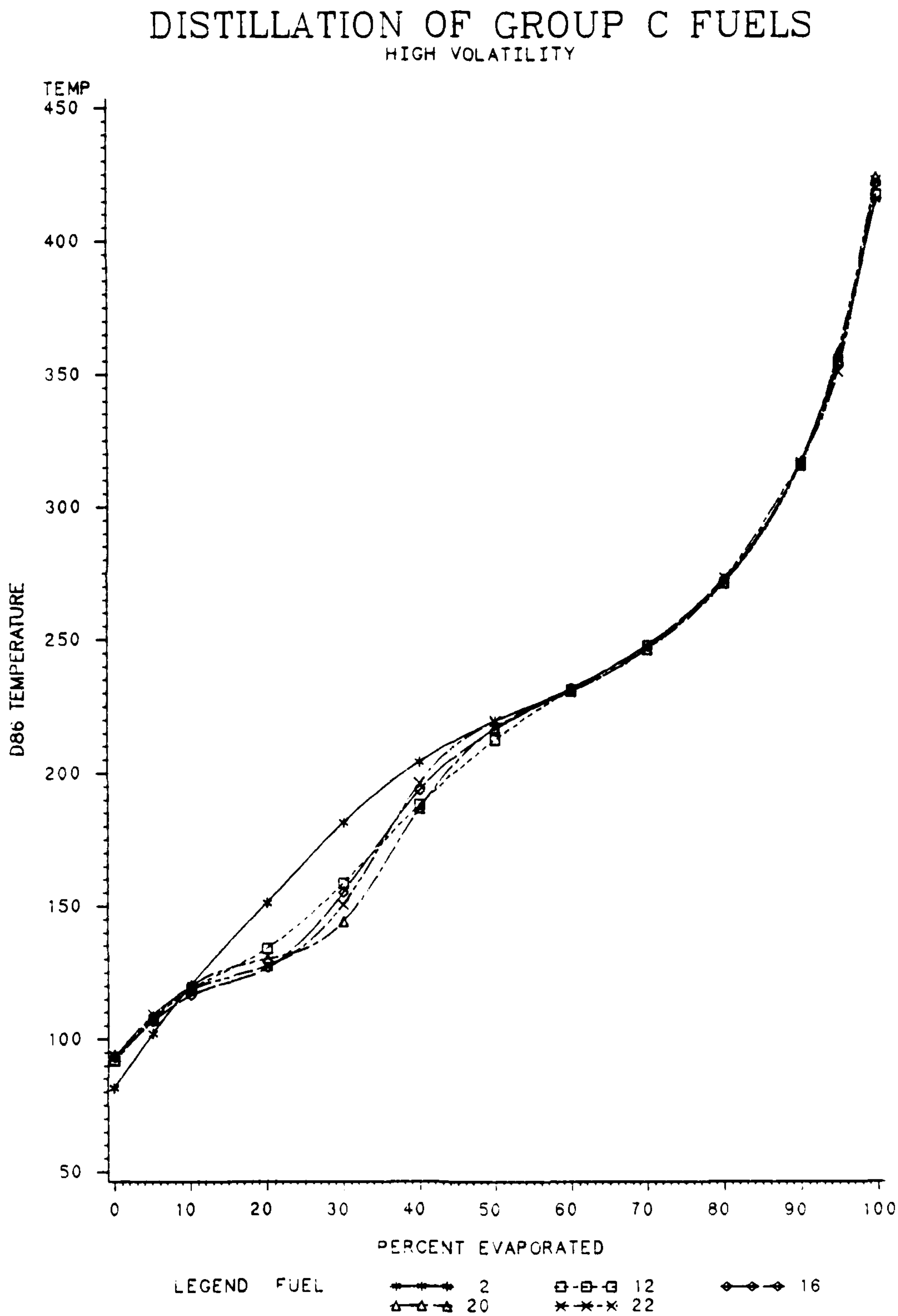

DISTILLATION OF GROUP C FUELS
LOW VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND. FUEL
1
11
15
19
21

FIGURE 7



DISTILLATION OF GROUP C FUELS
HIGH VOLATILITY
TEMP
450
400
350
300
250
200
150
100
50
D86 TEMPERATURE
0
10
20
30
40
50
60
70
80
90
100
PERCENT EVAPORATED
LEGEND FUEL
2
12
16
20
22

FIGURE 8

EFFECT OF METHANOL AND ETHANOL ON TWELVE-VEHICLE AVERAGE

SUBPROGRAM A

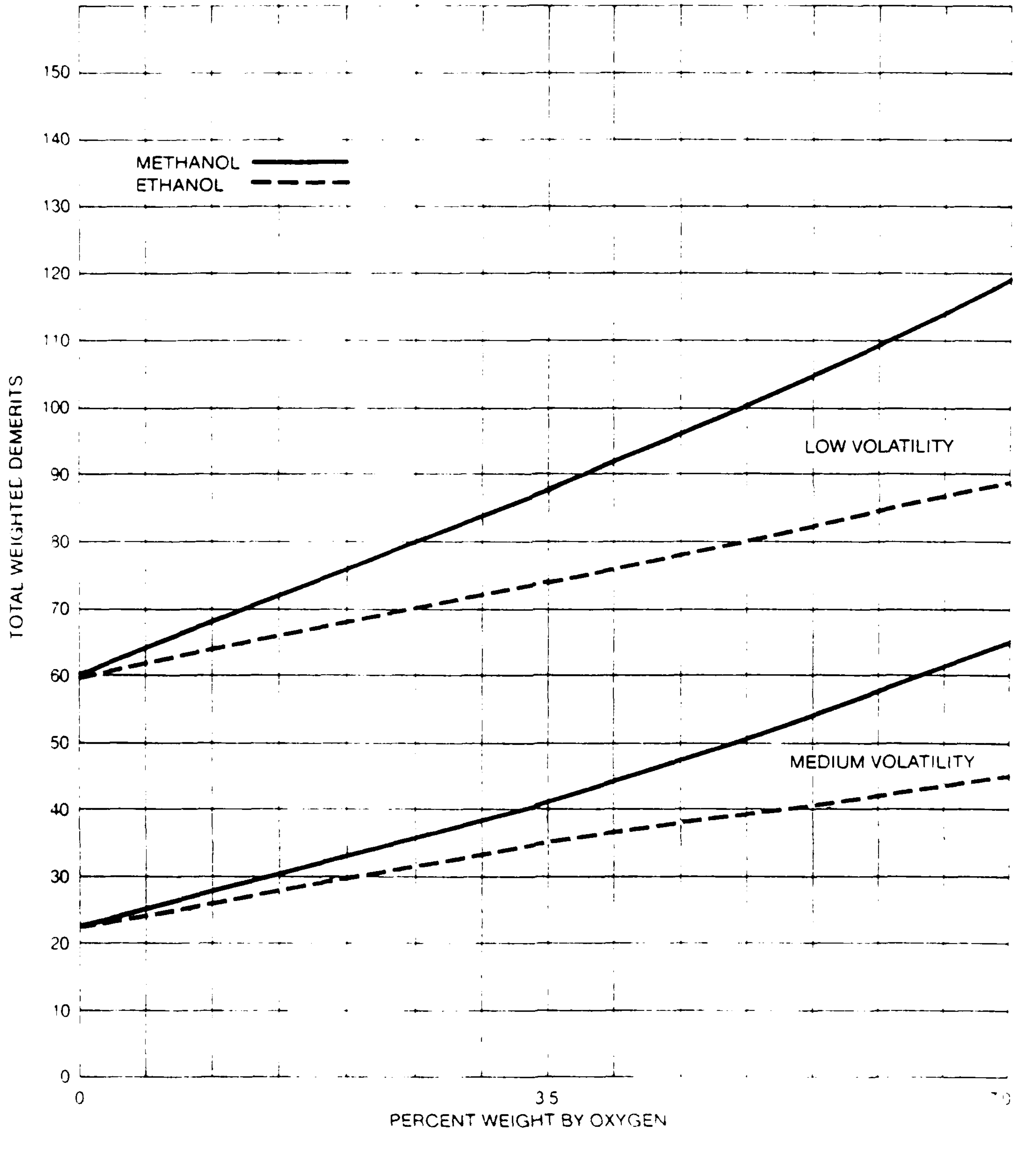


FIGURE 9

EFFECT OF ALCOHOL TYPE AND
EMISSIONS SYSTEM ON DRIVEABILITY

SUBPROGRAM A

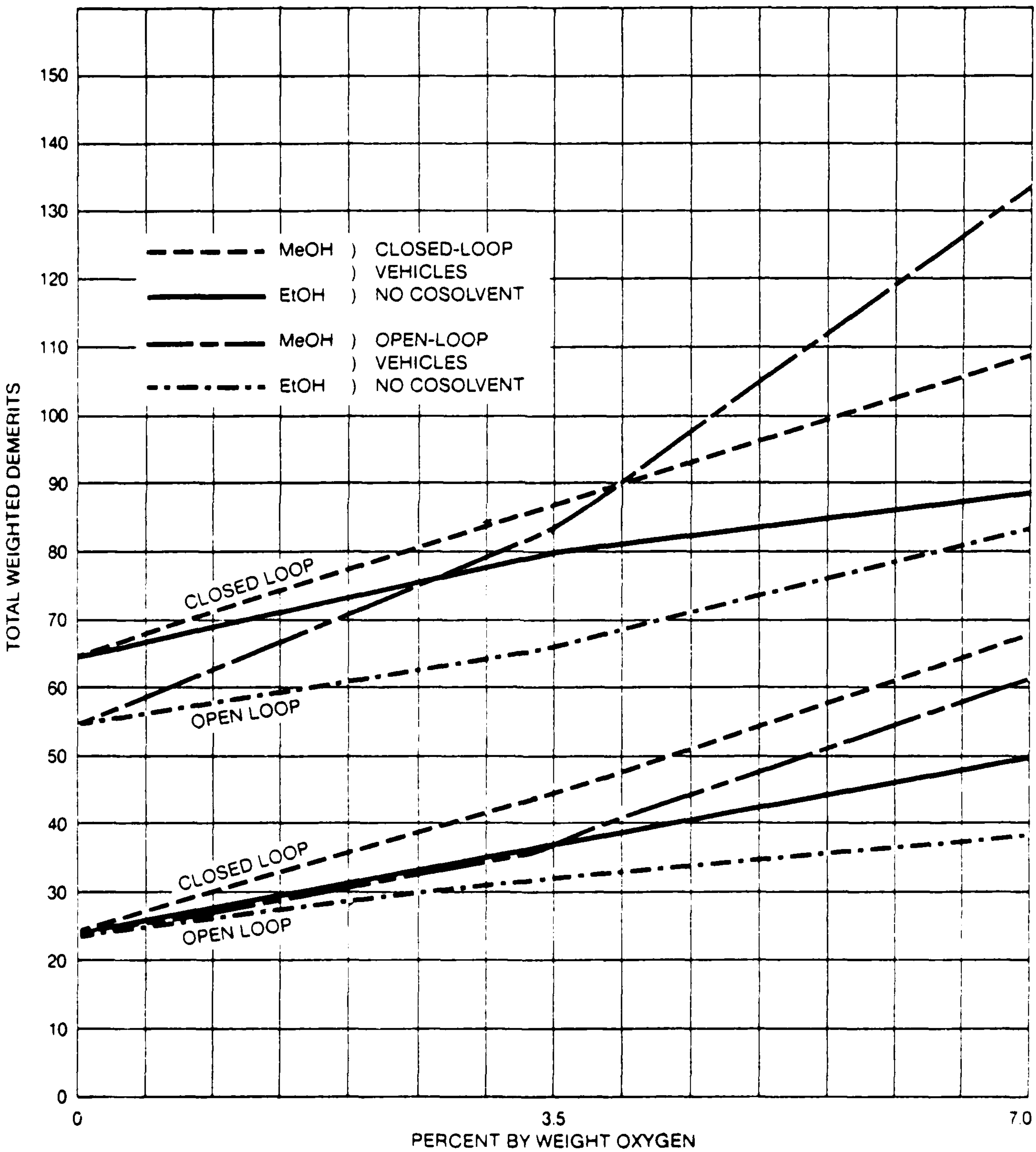


FIGURE 10

EFFECT OF ALCOHOL TYPE, VOLATILITY LEVEL, AND FUEL SYSTEM ON DRIVEABILITY

SUBPROGRAM A

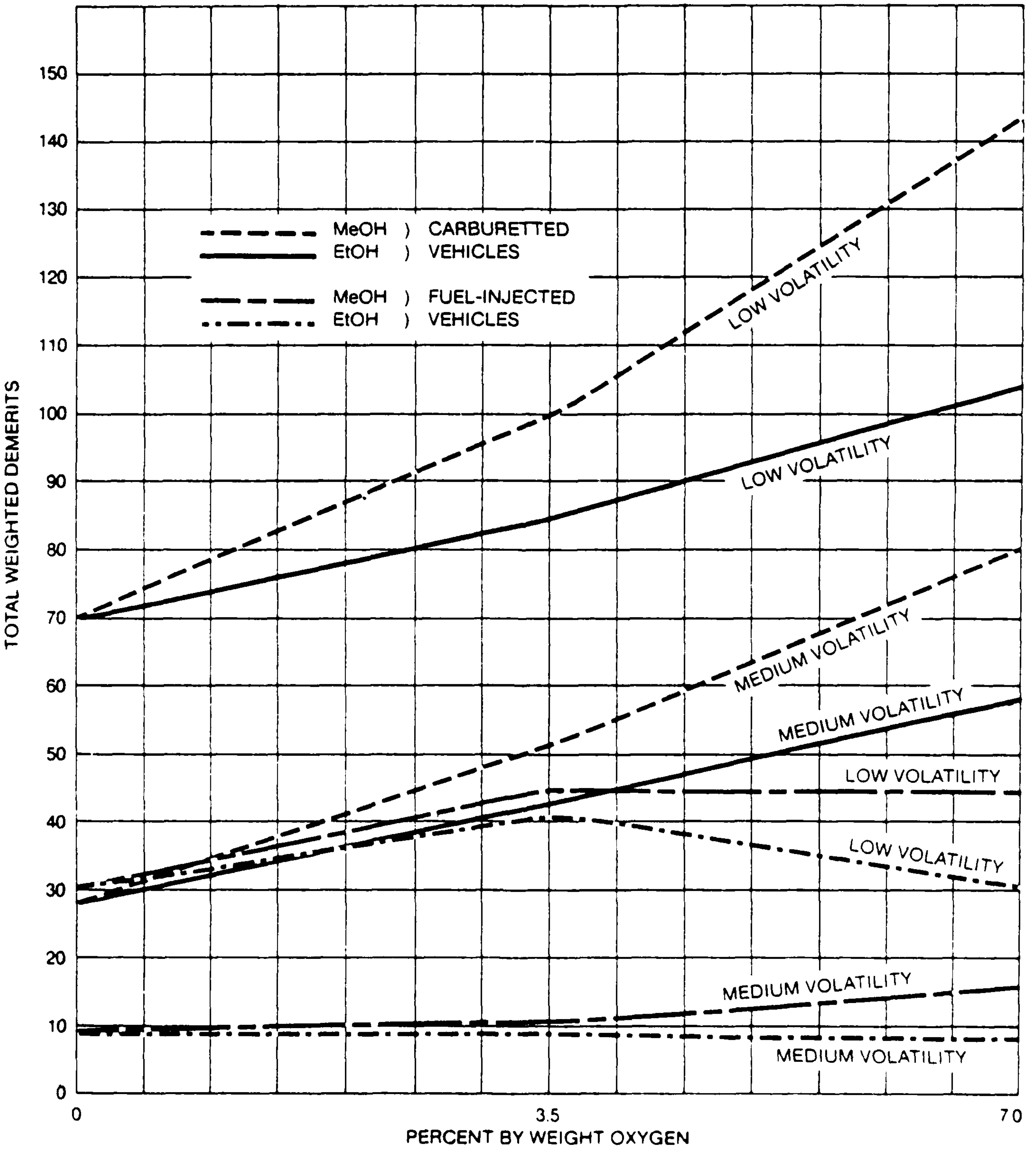


FIGURE 11

EFFECT OF METHANOL: GTBA RATIO
ON DRIVEABILITY

SUBPROGRAM B

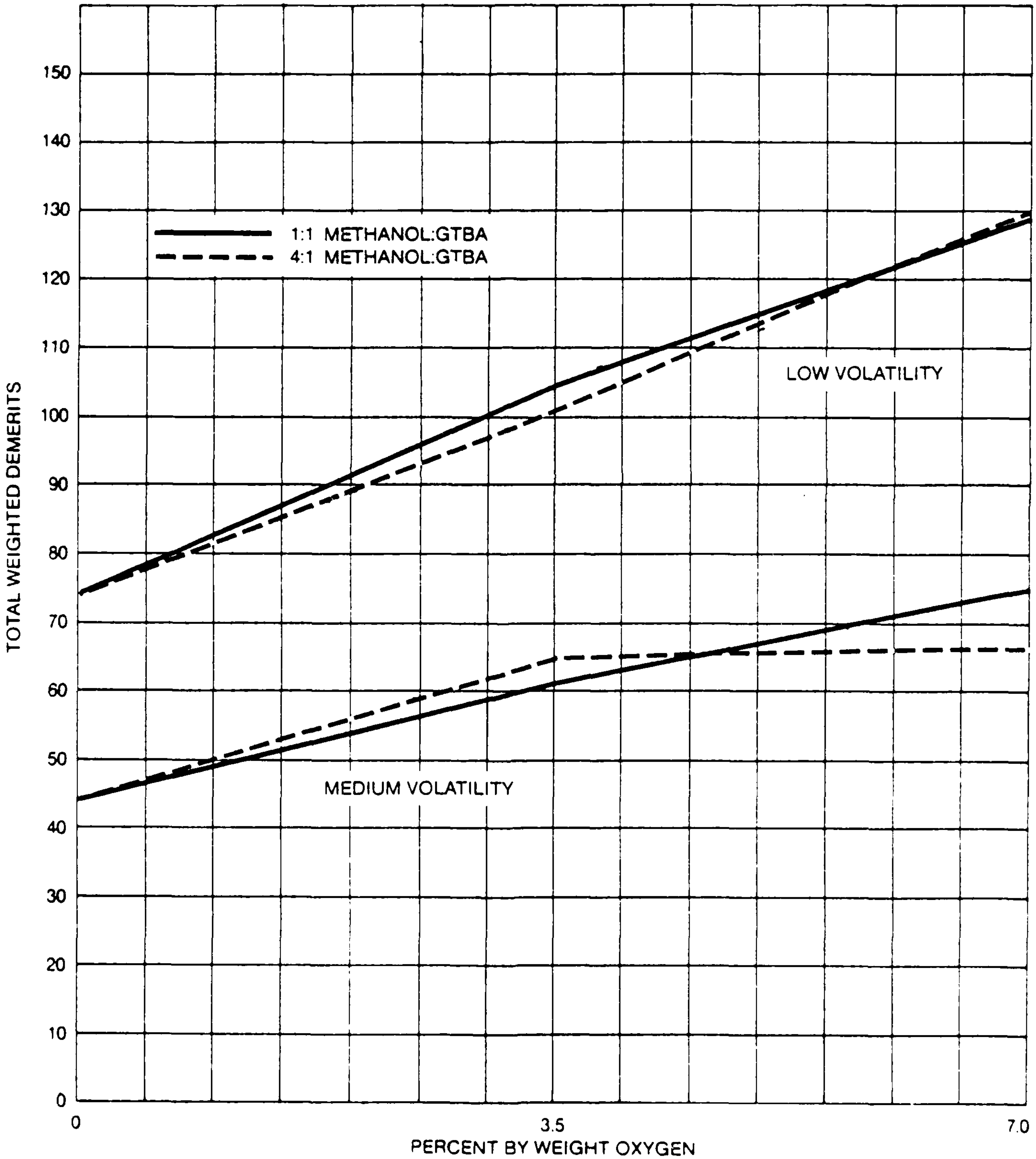


FIGURE 12

EFFECT OF METHANOL:GTBA RATIO, VOLATILITY LEVEL, AND EMISSIONS SYSTEM ON DRIVEABILITY

SUBPROGRAM B

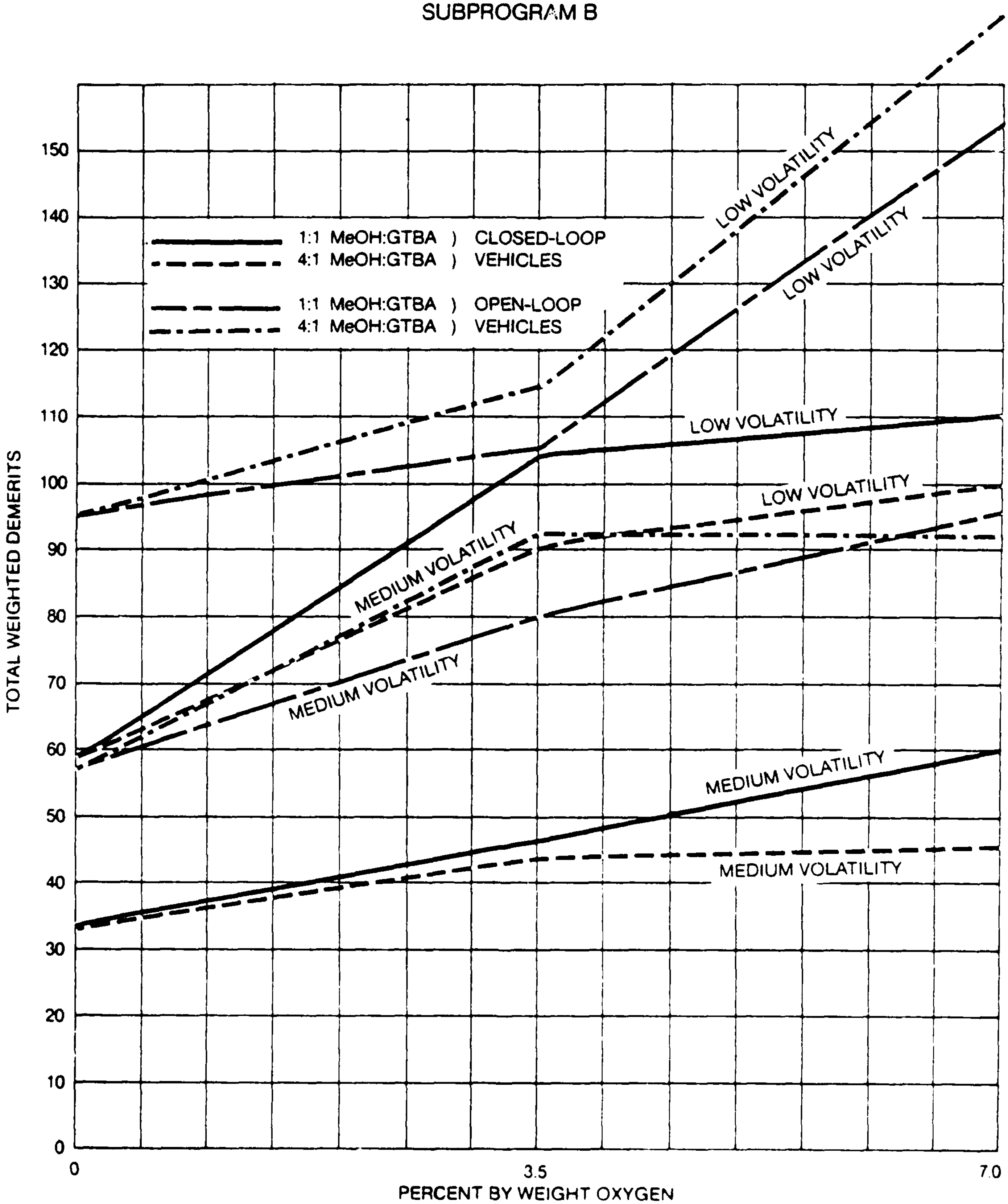


FIGURE 13

EFFECT OF METHANOL:GTBA RATIO AND FUEL SYSTEM ON DRIVEABILITY

SUBPROGRAM B

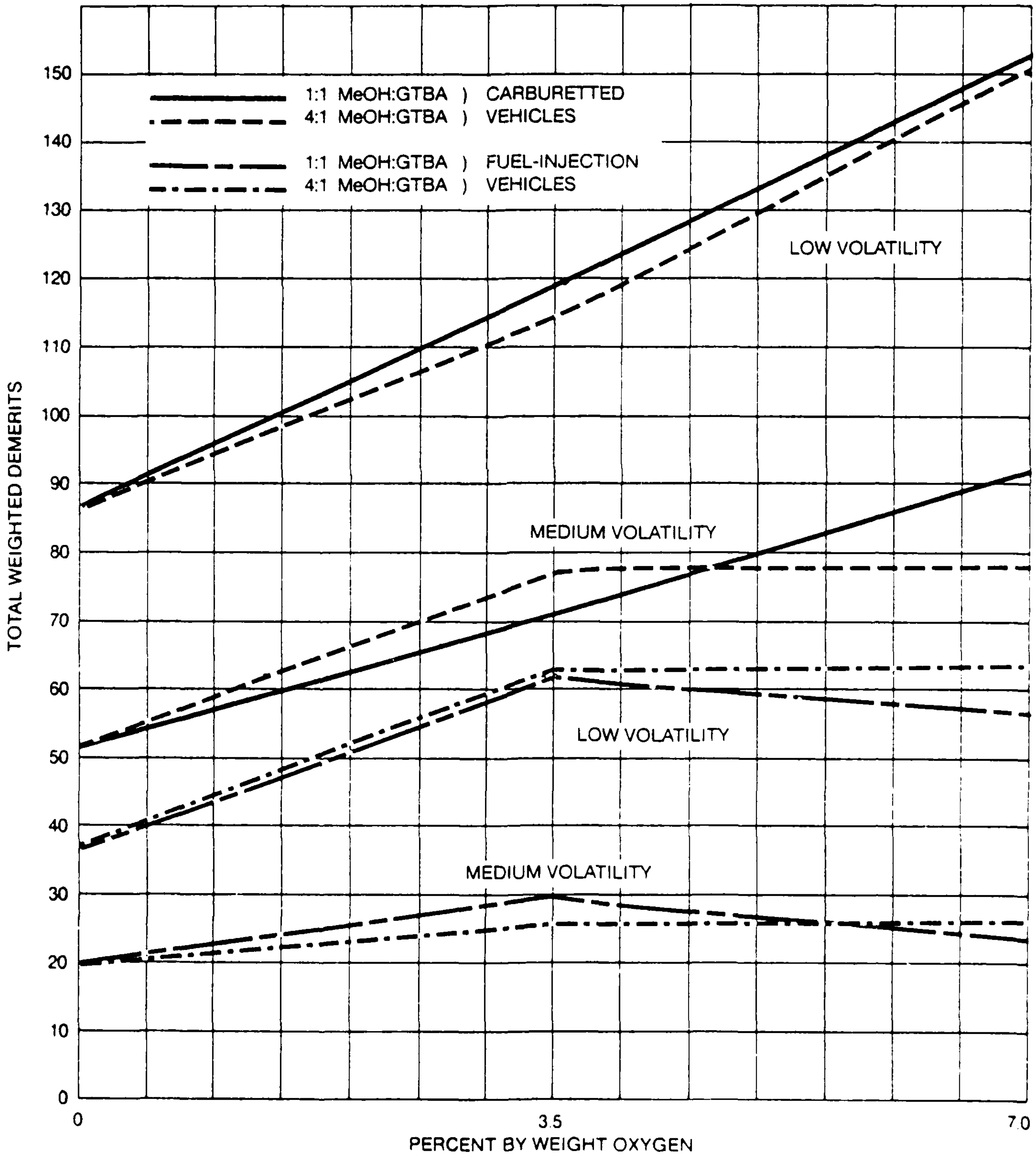


FIGURE 14

EFFECT OF COSOLVENT TYPE AND METHANOL:COSOLVENT RATIO ON DRIVEABILITY

SUBPROGRAM C

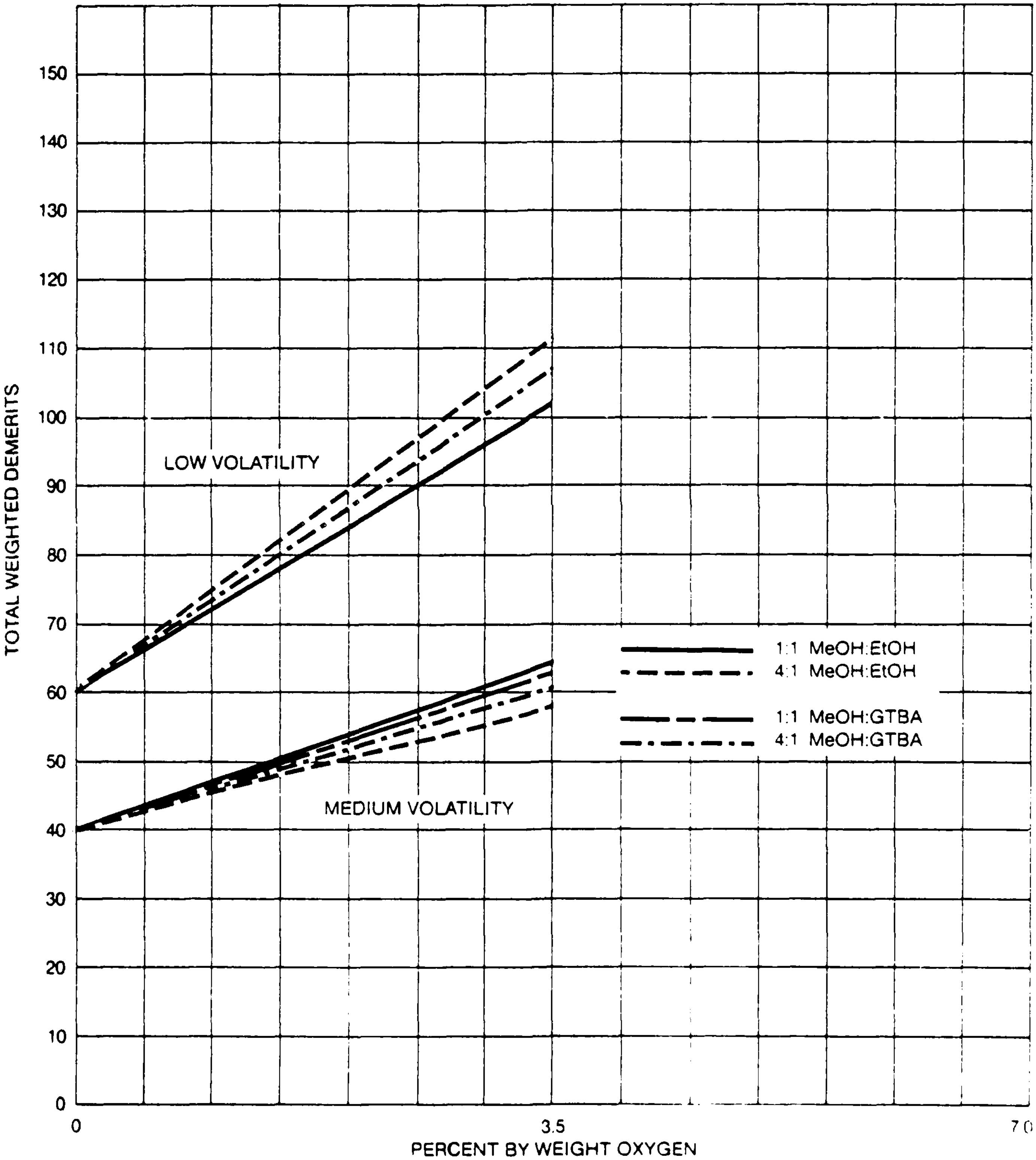


FIGURE 15

EFFECT OF COSOLVENT TYPE, METHANOL:COSOLVENT RATIO, AND EMISSIONS SYSTEM ON DRIVEABILITY

SUBPROGRAM C

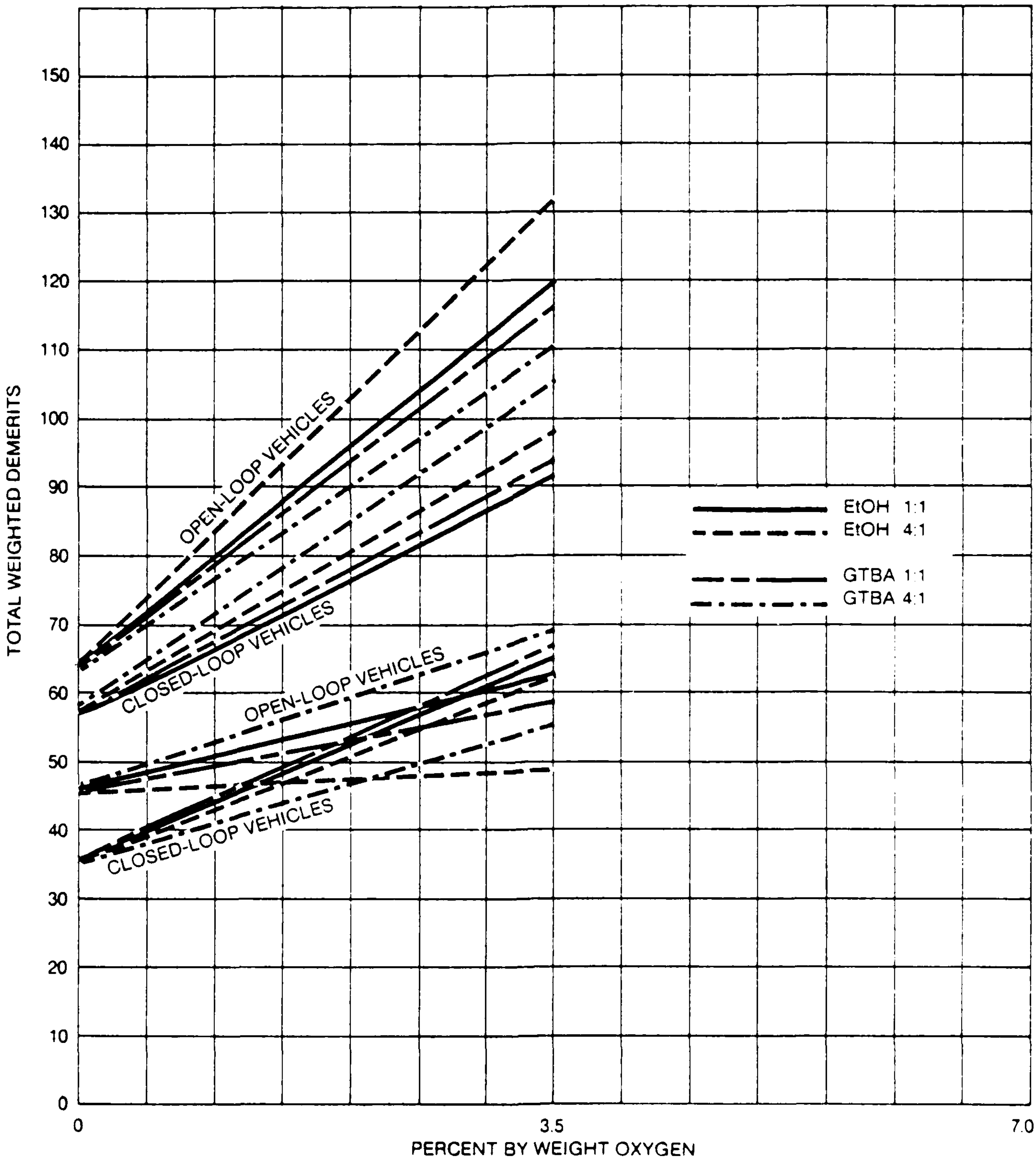


FIGURE 16

EFFECT OF COSOLVENT TYPE, METHANOL:COSOLVENT RATIO AND FUEL SYSTEM ON DRIVEABILITY

SUBPROGRAM C

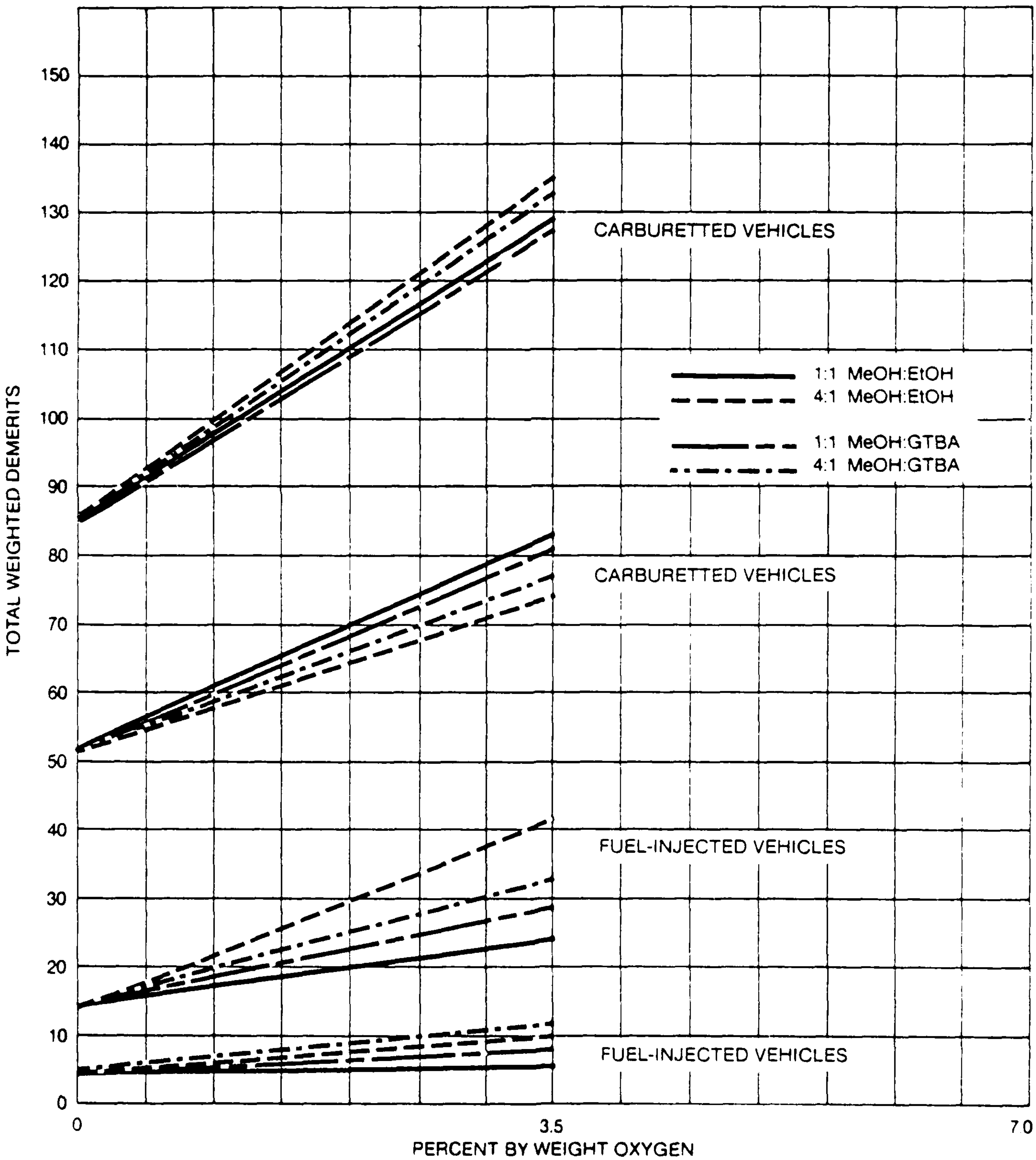


FIGURE 17

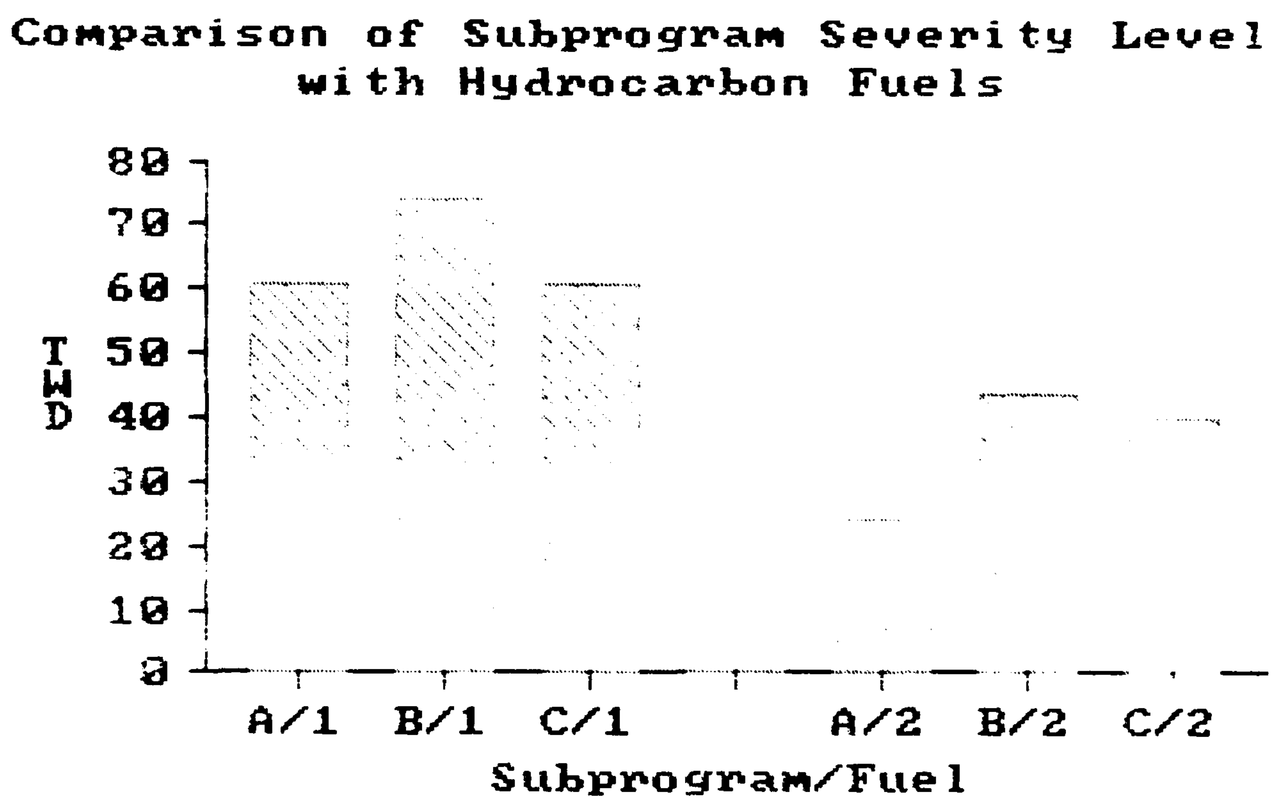
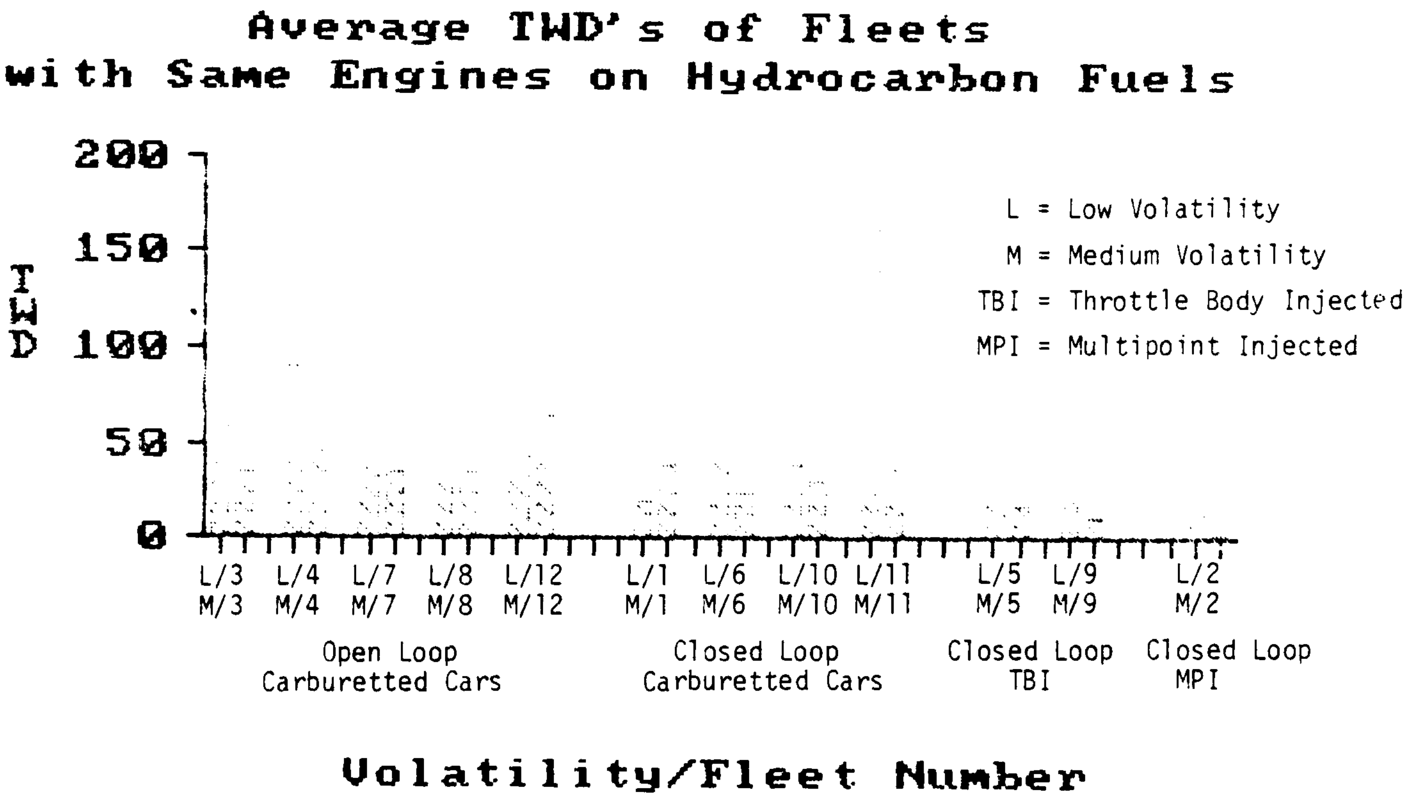

Comparison of Subprogram Severity Level
with Hydrocarbon Fuels
80
70
60
50
40
30
20
10
0
TWD
A/1
B/1
C/1
A/2
B/2
C/2
Subprogram/Fuel

FIGURE 18



Fleet Number	Vehicle Numbers
1	1, 21, 41
2	2, 22, 42
3	3, 23, 43
4	4, 24, 44
5	5, 25, 45
6	6, 26, 46
7	7, 27, 47
8	8, 28, 48
9	9, 29, 49
10	10, 30, 50
11	11, 31, 51
12	12, 32, 52

FIGURE 19

RANGE OF TOTAL WEIGHTED DEMERIT RESPONSE TO OXYGEN CONTENT IN LOW VOLATILITY FUELS

SUBPROGRAM B

HYDROCARBON FUELS AND 1:1 MeOH:GTBA FUELS

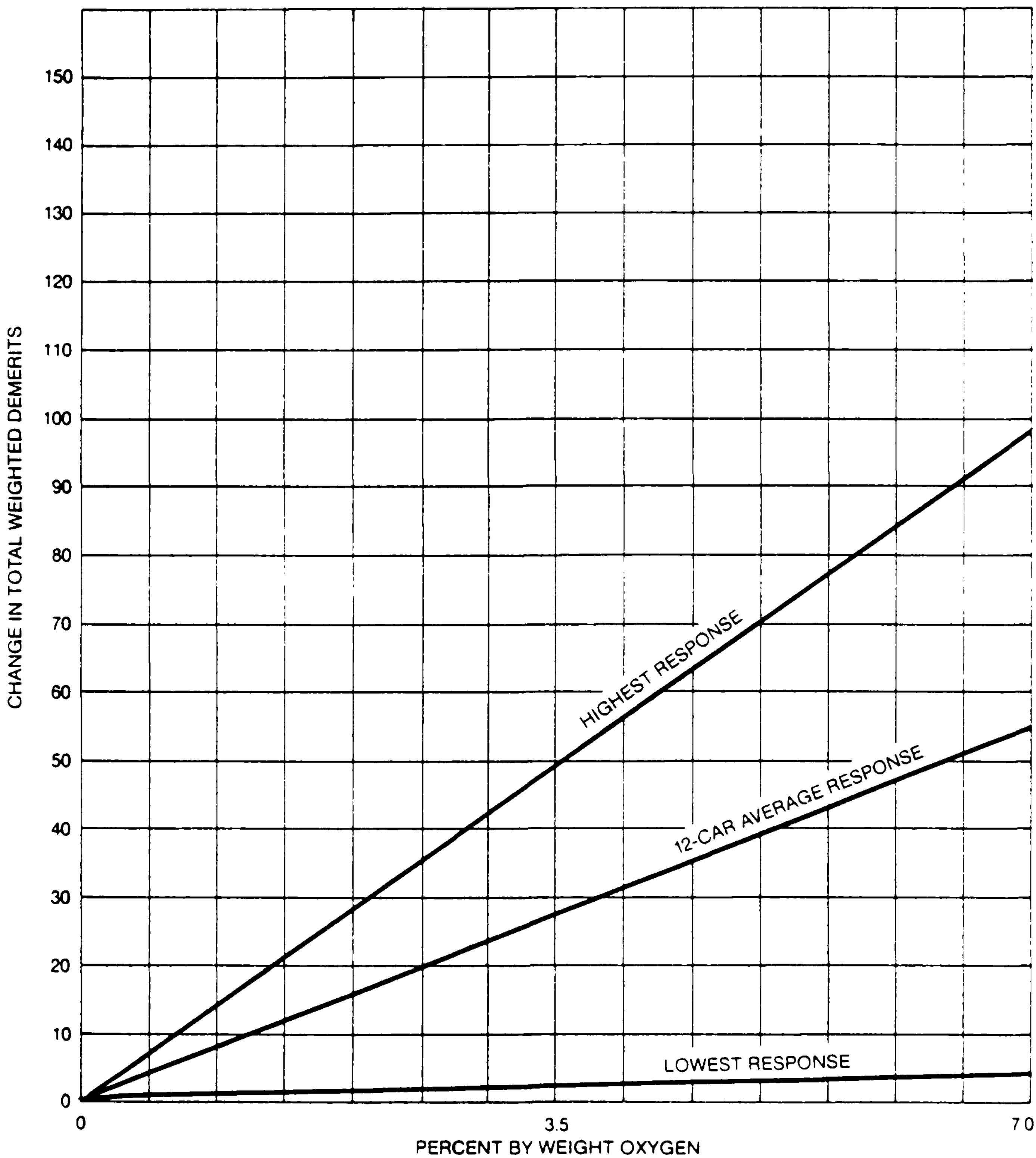


FIGURE 20

MEASURED TOTAL WEIGHTED DEMERITS
VERSUS PREDICTED TOTAL WEIGHTED DEMERITS

SUBPROGRAM A

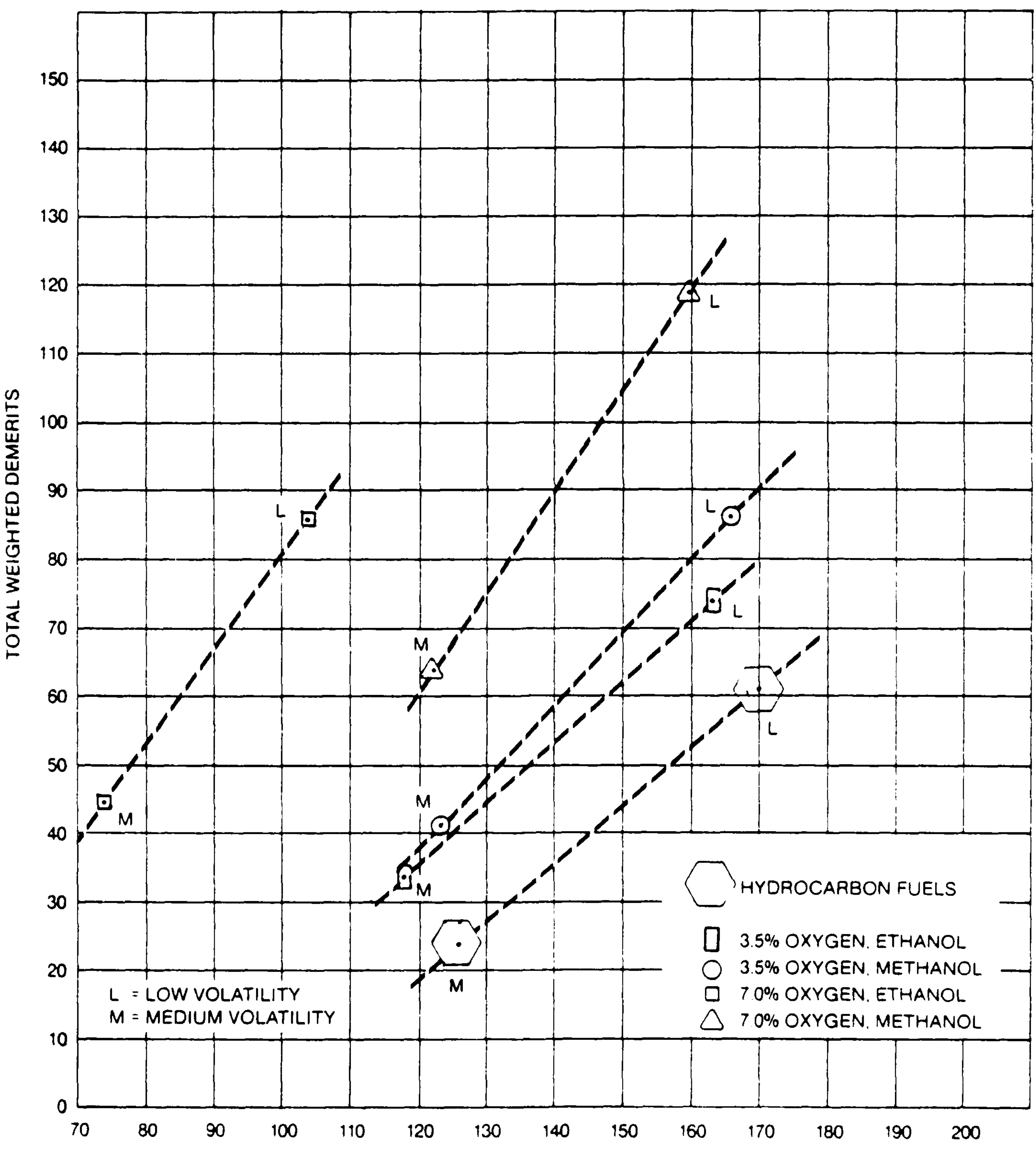


FIGURE 21

MEASURED TOTAL WEIGHTED DEMERITS
VERSUS PREDICTED TOTAL WEIGHTED DEMERITS

SUBPROGRAM B

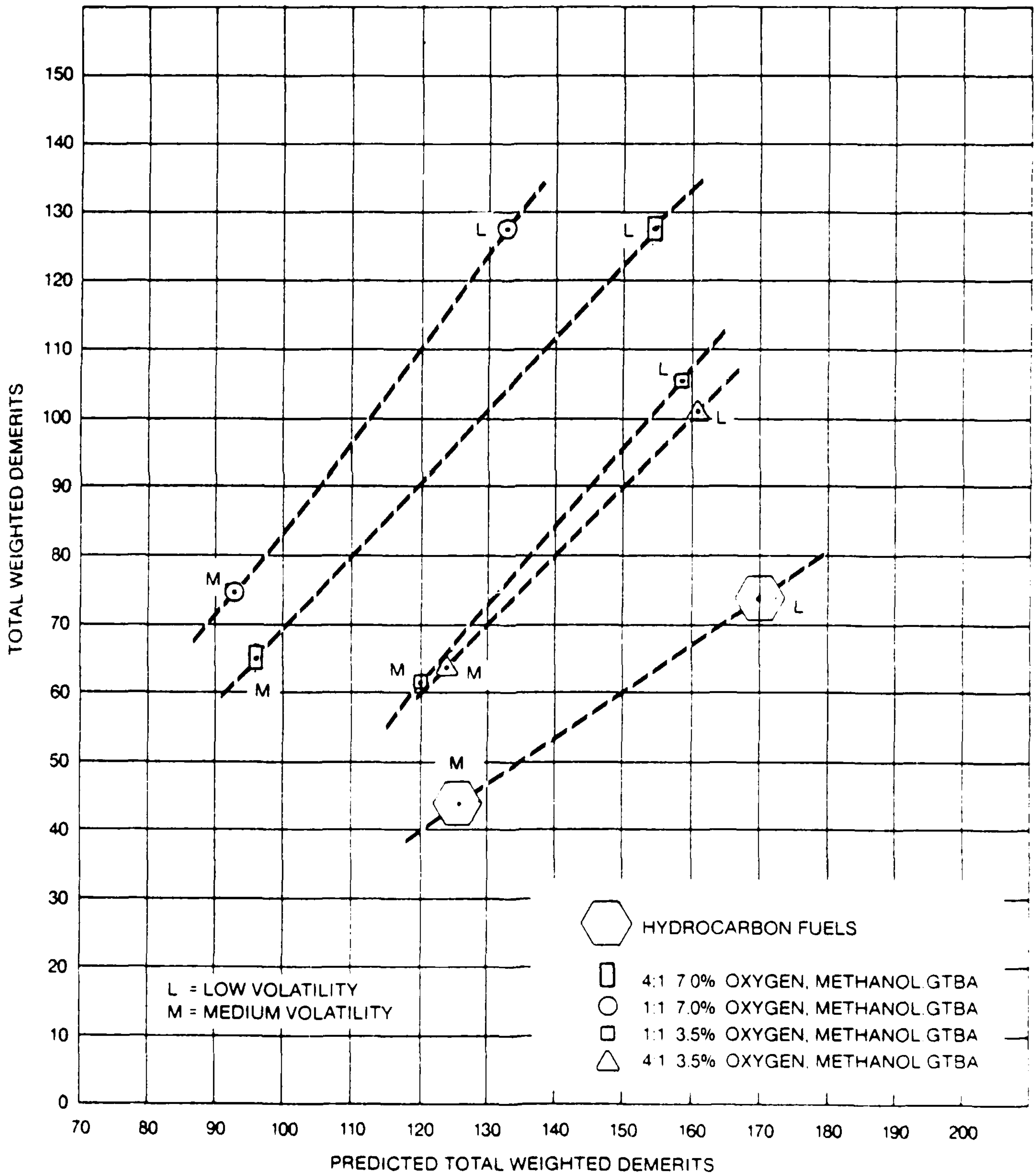


FIGURE 22

MEASURED TOTAL WEIGHTED DEMERITS
VERSUS PREDICTED TOTAL WEIGHTED DEMERITS

SUBPROGRAM C

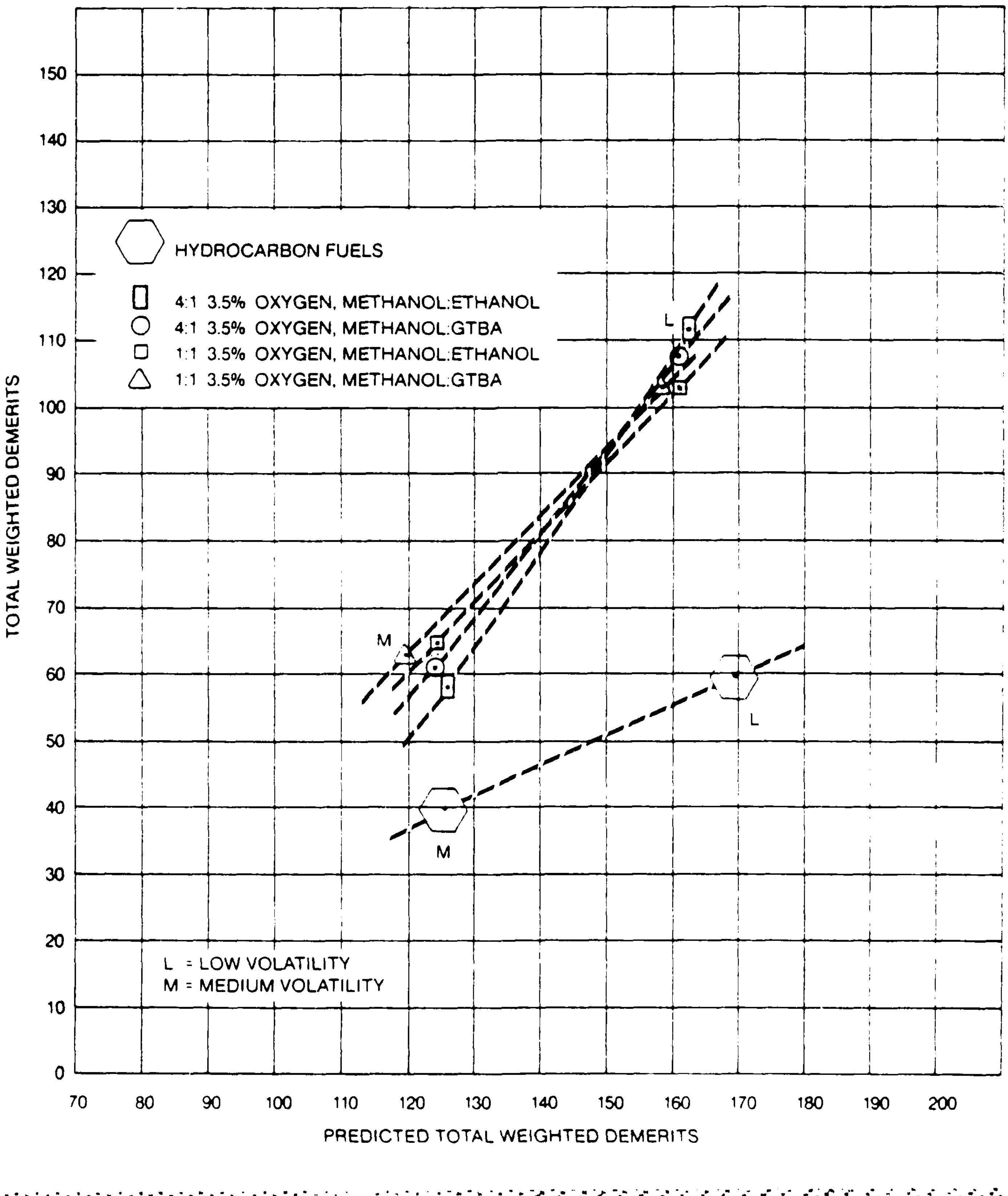
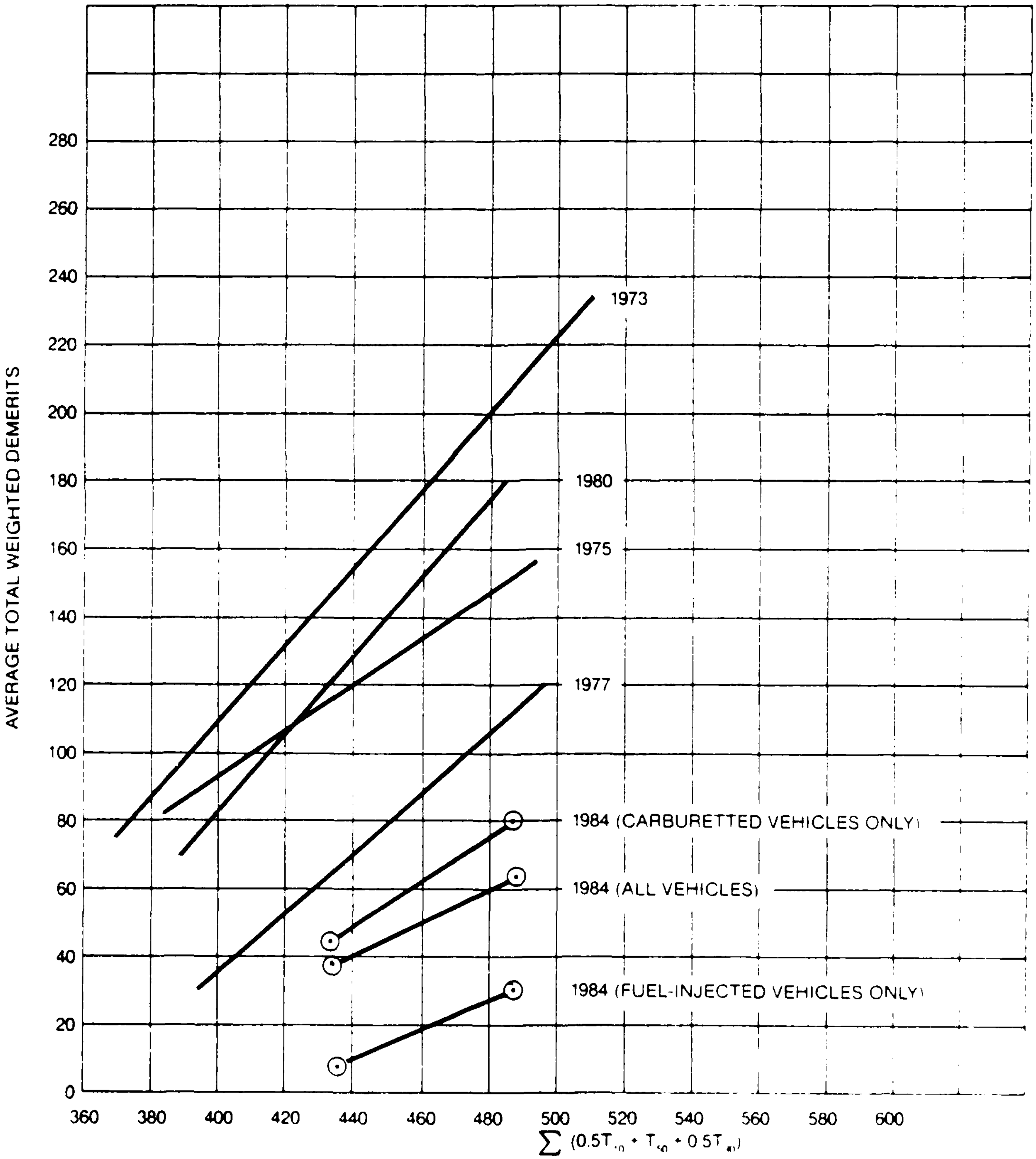


FIGURE 23

COMPARISON OF 1984 MODEL YEAR TOTAL WEIGHTED DEMERITS WITH PREVIOUS MODEL YEARS

(HYDROCARBON-ONLY FUELS)



A P P E N D I X   A

MEMBERSHIP:

1984 CRC VOLATILITY ANALYSIS PANEL

MEMBERSHIP OF THE

1984 CRC VOLATILITY ANALYSIS PANEL

Name	Company
J. C. Ingamells, Leader	Chevron Research Company
D. A. Barker	Shell Development Company
J. H. Baudino	ARCO Petroleum Products
P. W. Brigandi	Mobil Research & Development Corp.
T. E. Hayden	Texaco Inc.
A. T. Leard	Amoco Oil Company
J. E. Robinson	Standard Oil Company (Ohio)
E. D. Steinke	Sun Company

A P P E N D I X   B

PARTICIPATION:

1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM

PARTICIPANTS IN THE

1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM

Name	Company
Dave Barker	Shell Development Company
Jack Baudino	ARCO Petroleum Products Company
Paul Brigandi	Mobil Research & Development Corp.
Frank Clark	ARCO Petroleum Products Company
Brad Coy	Conoco
Doug Hall	Chevron Research Company
Tom Hayden	Texaco Inc.
Bruce Henderson	Amoco Oil Company
George Hyek	Gulf Research & Development Company
John Ingamells	Chevron Research Company
Alan Leard	Amoco Oil Company
Rich McMahon	Chrysler Corporation
Toshiharu Matsuura	Toyota Motor Company
Ted Naman	Conoco
Gary Ramsey	Tennessee Valley Authority
Jim Robinson	Standard Oil Company (Ohio)
Al Schanerberger	Ford Motor Company
Lou Steinke	Sun Company
Sam Wooters	Sun Company

APPENDIX C

1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM

COORDINATING RESEARCH COUNCIL
INCORPORATED
219 PERIMETER CENTER PARKWAY
ATLANTA, GEORGIA 30346
(404) 396-3400

1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM

CRC Project No. CM-118-84

Prepared by the

1984 Program Panel

of the

CRC Light-Duty Volatility Group

February 1984

1984 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM

Objective

Study the effects on cold start driveability performance at intermediate temperature of alcohol type, alcohol content, cosolvent type, and cosolvent ratio over a range of gasoline-oxygenate blend volatility.

Background

Oxygenated materials are being used in increasing volumes as blending components in fuels for spark-ignition engines because of their economic and octane benefits. A disadvantage of their use is a tendency toward increased cold start driveability malfunctions. Although a number of test programs have investigated this problem, many questions remain unanswered. This program will investigate several parameters which may influence cold start driveability with the use of alcohols. The result from this program will provide a possible basis for additional test programs.

Test Plan

The test plan consists of three separate investigations with three matched sets of twelve cars each. Items to be investigated are oxygen content at 3.5 and 7.0 wt. percent, oxygen type by methanol and ethanol, cosolvent ratios of 1:1 and 4:1, and cosolvent type as GTBA and ethanol. All investigations are at two volatilitiy levels equivalent to intermediate and low volatility gasoline blends. The test plan is outlined in Table C-I. Each car will rate ten fuels in duplicate for a total of twenty test days.

Vehicles in Group 1 will determine the effect of oxygen content on cold start driveability and determine if source (alcohol type) is an independent parameter not only characterized by oxygen* content. Two alcohols, methanol and ethanol, will each be evaluated at two oxygen levels of 3.5 and 7.0 wt. percent in gasoline at two volatility levels. The two alcohols chosen are different in most respects and are both used in commercial motor fuels. Cosolvent is not used so that potential differences in response due to alcohol type and level is maximized.

---

* Oxygen content is used only as a convenient nomenclature. It is not meant to distinguish between latent heat of vaporization, heating value or boiling point.

Results will be presented as TWD between the alcohol fuel and the gasoline base. Thus, a three point curve of ΔTWD versus O_2 content (0, 3.5, 7.0 wt. percent) will be obtained for methanol and ethanol at each of two distinct volatility levels. Breakdown by fuel delivery and emission systems will include which systems are responsive to oxygen content or source.

Vehicles in Group 2 will also determine oxygen content effects, and they will determine the effect of cosolvent ratios at two oxygen levels. The cosolvent used in this study is GTBA. Cars in this group will be tested on gasoline and alcohol blends containing 1:1 and 4:1 cosolvent ratios at O_2 contents of 3.5 and 7.0 wt. percent. Two fuel volatilities will be tested. Results will be presented similarly as for Group 1 cars. The results (deltas) are likely to be less than those for methanol as determined by Group 1 cars. The question within this narrowed range is if there is an appreciable difference attributable to cosolvent ratio.

Vehicles in Group 3 will determine the effect of cosolvent type at two cosolvent ratios on cold start driveability. Cosolvents used in this study are GTBA, which is used commercially, and ethanol, which has been suggested as an alternate cosolvent. GTBA and ethanol are different enough in properties to likely show importance of colsolvent type in cold start driveability performance. Cars in this group will be tested on gasoline and fuels containing 3.5 wt. percent O_2 with cosolvents of GTBA and ethanol at cosolvent ratios of 1:1 and 4:1. Two volatility levels will be tested. Results will be presented similarly as for Group 1 cars.

There are other oxygenates (ether, etc.) which could be used in the test fuels. They would be expected to have lesser effects than the alcohol blends selected for evaluation in this program. They may be included in future programs if results of this program indicate a need to study individual oxygenates separately.

Test Fuels

Test fuels will consist of two base fuels of intermediate and low volatility. Specifications for finished fuels are shown in Table C-II. The base blends will be designed so that the addition of butane for gasoline blends will give the RVP and distillations as shown in Table C-II. The addition of the various alcohols plus butane trimming as necessary will give similar RVP's for the alcohol blends. Other fuel adjustments for alcohol fuels were discussed but were considered to overcomplicate fuel blending and not necessary to meet the objectives of the program.

The test fuels in this program are not designed to develop an equation for predicting driveability performance as a function of volatility parameters for alcohol-containing fuels. It is hoped that by thorough characterization of the test fuels there will be indications of the important parameters for a driveability prediction equation. Development of such an equation would be an objective of a future program. Characteristics of the test fuels to be run by individual laboratories is as follows:

RVP, psi (Dry Method, Modification of D 323)
Distillation (D 86)
Gravity
$T_{V/L}$ at 5, 10, 15, 20, 30, 45 (Hg Modification of D 2533)
FIA (Base Fuels)
GC (Base Fuels)
Alcohol Content, Vol % (GC)
Oxygen Content, wt %
Latent Heat Vaporization (Calculated and Measured)
Net Heating Value (Modified D 240)

Test fuels will be provided to any laboratory or organization that desires to measure other fuel parameters.

Test Cars

Each of the three test groups will contain twelve matched vehicles. The vehicles will represent different design technologies of carburetted open-loop, carburetted closed-loop, throttle-body injection, port injection, and port injection turbocharged. The desired car list is shown in Table C-III. All cars are to be 1984 models equipped with automatic transmissions.

Car preparation will include:

-- Tune-up to manufacturers specifications

-- Installation of fuel tank drains

-- Installation of manifold vacuum tap

Test Procedure

The test procedure will be basically the CRC Cold Start and Warm-up Driveability Procedure as previously run in 1980. A procedure modification is made by adding two additional cycles at the end of the procedure. Previous experience has shown that very few warm-up malfunctions are encountered in the last cycle of the normal six cycles. This indicates that the engine has approached a stable

temperature condition. The additional two cycles are to be used to indicate warmed-up driveability malfunctions. This is of particular interest with fuels containing higher percentages of alcohol. Cold start driveability data analysis will be based on the initial six cycles as in previous test programs. The last two cycles will be analyzed separately to indicate warmed-up driveability malfunctions. The procedure and rating system are included as Attachment 1.

Program Duration and Manpower Requirement

Program duration is 4-1/2 weeks, as outlined in Table C-IV. Manpower requirements are twelve to fifteen personnel on site at all times, dependent upon the number of raters. The program is runable with three raters. With three raters, each crew would test twelve cars daily. With the extended test procedure of eight cycles this could cause difficulty in minimizing test temperature variation. It is estimated that it would require five hours for a test crew to complete twelve runs plus additional time to help prepare vehicles for the next day's runs. This could cause difficulty in staying within the test temperature band of 40 to 60°F for the five-hour test period. With six raters, each crew would test six cars daily. It is estimated that three hours would be required to complete six runs allowing for additional time for track scheduling. The three-hour test time band would allow more flexibility to choose the time of day for running, thus minimizing ambient temperature variations. With six test crews, extra personnel for defueling, fueling, and running in cars for the next day's runs would not be necessary. If manpower is available, six test crews is recommended.

It would be desirable for continuity and minimizing rater training that raters participate for the full program time of 4-1/2 weeks. It is possible for three or six raters to complete a fuel set on each group of cars and have three or six different raters for the repeat runs. This would require at least one extra day in the middle of the test program for rater training. In any case, a fuel set for any particular car would be completed by a single rater. The duplicate run would be made by a different rater. Rater corrections are not needed within a car group in that fuel comparisons are based on a car-rater combination. If comparisons are desired between car groups, corrections can be made on the car-rater combination run on the common gasoline fuels.

Test Location and Timing

The program will be run in the period of September through November 1984. A specific time period is dependent upon test location. Test location has not been finalized. It is dependent upon suitable roads or track, expected weather conditions, and availability.

TABLE C-I

TEST PLAN

Oxygenate	Oxygen Content wt %	CoSolvent Ratio	CoSolvent Type	Fuel Volatility	Fuel Blend Nos.
Car Group 1					
None	0.0	1:0	--	Low & Int.	1 & 2
Methanol	3.5	1:0	--	Low & Int.	3 & 4
Methanol	7.0	1:0	--	Low & Int.	5 & 6
Ethanol	3.5	1:0	--	Low & Int.	7 & 8
Ethanol	7.0	1:0	--	Low & Int.	9 & 10
Car Group 2					
None	0.0	--	--	Low & Int.	1 & 2
Meth/TBA	3.5	1:1	GTBA	Low & Int.	11 & 12
Meth/TBA	7.0	1:1	GTBA	Low & Int.	13 & 14
Meth/TBA	3.5	4:1	GTBA	Low & Int.	15 & 16
Meth/TBA	7.0	4:1	GTBA	Low & Int.	17 & 18
Car Group 3					
None	0.0	--	--	Low & Int.	1 & 2
Meth/TBA	3.5	1:1	GTBA	Low & Int.	11 & 12
Meth/TBA	3.5	4:1	GTBA	Low & Int.	15 & 16
Meth/Eth	3.5	1:1	Ethanol	Low & Int.	19 & 20
Meth/Eth	3.5	4:1	Ethanol	Low & Int.	21 & 22

All fuels to be rated in duplicate.

TABLE C-II

TEST FUEL SPECIFICATIONS

	Finished Gasoline Test Fuels		Finished Alcohol Blend Fuels	
	Low Volatility	Intermed. Volatility	Low Volatility	Intermed. Volatility
RVP, psi	9.0	11.0	9-9.5[b]	11-11.5[b]
Distillation Temp., °F				
10% Evap.	135±10[a]	115±10[a]	(c)	(c)
50% Evap.	240±10[a]	210±10[a]	(c)	(c)
90% Evap.	350±10	330±10	(c)	(c)
(R+M)/2, Min.	88	88	88	88
Fuel Condition	(Clear and Bright)		(d)	(d)
Benzene Content %, Max.	5	5	5	5
Corrosion Inhibitor, PTB	3	3	3	3
Antioxidant, PTB	5	5	5	5
Composition	Normal Refinery Components 25-35% Aromatic Content			

(a) The minimum delta between low and intermediate fuels will be 20°F for the 10% evaporated point and 25°F for the 50% evaporated point.

(b) Alcohols as specified will be added to the base fuels and pressurized as necessary with butane to meet the RVP specification.

(c) The distillation values of the alcohol blends will be dependent upon the base fuels used to meet the finished gasoline specifications and the addition of specified alcohols.

(d) Must not phase-separate when cooled down to 30°F.

TABLE C-III

TEST CARS

Manufacturer	Displacement	Fuel System	Emission System
General Motors	3.8	Carburetted	Closed-Loop
General Motors	2.8	Carburetted	CLosed-Loop
General Motors	2.5	Throttle-Body Injection	Closed-Loop
General Motors	3.8	Port Injection	Closed-Loop
Ford	1.6	Carburetted	Open-Loop
Ford	3.8	Carburetted	Open-Loop
Ford	3.8	Throttle-Body Injection	Closed-Loop
Ford	2.3	Carburetted	Closed-Loop
Chrysler	2.2	Throttle-Body Injection	Closed-Loop
Chrysler	2.2	Port Injection Turbocharged	CLosed-Loop
Nissan Sentra	1.5	Carburetted	Open-Loop
Toyota Corolla	1.6	Carburetted	Closed-Loop

TABLE C-IV

PROGRAM DURATION AND MANPOWER REQUIREMENTS

Program Duration	Days Required Per Test Phase
Preparation and Driver Selection	3
Testing	20
Weekend and Weather Allowance	8
Total Days	31

Manpower Requirement	Number Required	
	3 Raters	6 Raters
Raters	3	6
Observers	3	6
Car Preparation	3	0
Track Scheduling	1	1
Data Handling	2	2
Total	12	15

CRC COLD START AND WARMUP DRIVEABILITY PROCEDURE

TEST PROCEDURE AND DATA RECORDING

A. Record all necessary test information at the top of the data sheet.

B. Start engine per Owner's Manual Procedure. Record start time.

C. If engine fails to start after 15 seconds of cranking, stop cranking and depress accelerator pedal to the floor once and release. Begin cranking and record total cranking time until engine starts.

D. Record idle quality in "Neutral" or "Park" immediately after start; foot should be removed from accelerator pedal.

E. If engine stalls, repeat Steps B and C. Record number of stalls and starting time of required restarts.

F. Allow engine to idle 15 seconds. Apply brakes (right foot), shift to normal drive range, and record idle quality. If engine stalls, restart immediately. Do not record restart time. Record number of stalls. Idle 5 seconds in "Drive".

This completes the start-up portion of the procedure. Note that space on the data sheet has only been provided for two restart times at any idle condition. If three stalls occur at any condition, record the three stalls, restart (without recording time) and proceed to the next scheduled condition.

G. After 5 seconds in "Drive" (Step F), make a light throttle (Lt. th) acceleration from 0-25 mph at constant throttle opening beginning at the predetermined manifold vacuum.* Cruise at 25 mph. At the 0.2 mile marker open throttle to the detent position and accelerate from 25 to 35 mph at constant throttle in high gear. Decelerate to a stop, and at the 0.3 mile marker make a WOT acceleration from 0 to 35 mph. Decelerate to 10 mph and at mile marker 0.4 accelerate at light throttle from 10 to 25 mph. Definitions of light throttle, detent, and WOT accelerations are attached.

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* Marked on vacuum gauge.

H. During the above maneuvers, observe and record the severity of any of the following malfunctions (see attached definitions):

1. Hesitation
2. Stumble
3. Surge
4. Stall
5. Backfire

Record maneuvering stalls on the data sheet in the appropriate column: accelerating or decelerating. In addition, measure and record the time required to accelerate from 0-25 on the 0-25 mph maneuver.

I. At the 0.5 mile marker, brake moderately to a stop on the right side of the roadway. Idle for 30 seconds in Drive. Record idle quality and number of stalls.

J. Perform Steps G, H, and I three times (1.5 miles). The mile marker for the beginning of each maneuver is indicated on the data sheet.

K. At mile marker 1.5, after completing the 30-second idle, make a crowd acceleration (constant predetermined vacuum) from 0-45 mph. Four-tenths of a mile is provided for this maneuver. Decelerate from 45 to 25 mph at the 1.9 mile marker, and open throttle to detent position and accelerate from 25 to 35 mph. At 2.0 miles decelerate to a stop and accelerate from 10 to 25 mph at light throttle. Rate and record malfunctions in these maneuvers as in Step H. Measure and record the time required to travel the first 0.3 miles of the 0-45 mph crowd maneuver. Idle 30 seconds in Drive as in Step I.

L. Perform Step K five times. Appropriate mile markers for the start of each maneuver are shown on the data sheet.

DEFINITIONS AND EXPLANATIONS

Test Run

Operation of a car throughout the prescribed sequence of operating conditions and/or maneuvers for a single test fuel.

Maneuver

A specified single vehicle operation or change of operating conditions (such as idle, acceleration or cruise) that constitutes one segment of the driveability driving schedule.

Cruise

Operation at a prescribed constant vehicle speed with a fixed throttle position on a level road.

Wide Open Throttle (WOT) Acceleration

"Floorboard" acceleration through the gears from prescribed starting speed. Rate at which throttle is depressed is to be as fast as possible without producing tire squeal or appreciable slippage.

Part-Throttle (PT) Acceleration

An acceleration made an any defined throttle position, or consistent change in throttle position, less than WOT. Several PT accelerations are used. They are:

1. Light Throttle (Lt. Th) - All light throttle accelerations are begun by opening the throttle to an initial manifold vacuum and maintaining constant throttle position throughout the remainder of the acceleration. The vacuum selected is one inch Hg greater than the initial power cut-in vacuum obtained from carburetor flow curves. However, if a 0-25 mph light throttle maneuver (car warmed up) cannot be completed in 0.1 mile, vacuum is decreased in steps of one inch Hg until the 0-25 maneuver can be completed in 0.1 mile. The selected vacuum is posted in each car.

2. Crowd - An acceleration made at a constant intake manifold vacuum. To maintain constant vacuum, the throttle opening must be continually increased with increasing engine speed. Crowd accelerations are performed at the same vacuum prescribed for the light throttle acceleration.

3. Detent - All detent accelerations are begun by opening the throttle to the downshift position as indicated by transmission shift characteristic curves. Manifold vacuum corresponding to this point at 25 mph is posted in each car. Constant throttle position is maintained to 35 mph in this maneuver.

Malfunctions

1. Stall

   Any occasion during a test when the engine stops with the ignition on. Three types of stall, indicated by location on the data sheet, are:

   a. Stall; idle - Any stall experienced when the vehicle is not in motion, or when a maneuver is not being attempted.

   b. Stall; maneuvering - Any stall which occurs during a prescribed maneuver or attempt to maneuver.

   c. Stall; decelerating - Any stall which occurs while decelerating between maneuvers.

2. Idle Roughness

   An evaluation of the idle quality or degree of smoothness while the engine is idling.

3. Backfire

   An explosion in the induction or exhaust system.

4. Hesitation

   A temporary lack of vehicle response to opening of the throttle.

5. Stumble

   A short, sharp reduction in acceleration after the vehicle is in motion.

6. Surge

   Cyclic power fluctuations occurring during acceleration or cruise.

Malfunction Severity Ratings

The number of stalls encountered during any maneuver are to be listed in the appropriate data sheet column. Each of the other malfunctions must be rated by severity and the letter designation entered on the data sheet. The following definitions of severity are to be applied in making such ratings.

1. Trace (T) - A level of malfunction severity that is just discernible to a test driver but not to most laymen.

2. Moderate (M) - A level of malfunction severity that is probably noticeable to the average layman.

3. Heavy (H) - A level of malfunction severity that is pronounced and obvious to both test driver and layman.

Enter a T, M, or H in the appropriate data block to indicate both the occurrence of the malfunction and its severity. More than one type of malfunction may be recorded on each line. If no malfunctions occur, enter a dash (-) to indicate that the maneuver was performed and operation was satisfactory during that maneuver.

CRC driveability data sheet

Card	Run No	Car	Fuel	Rater	Date	Time	Temperatures: Soak	Temperatures: Run	Starting Time, sec.: Initial	Restart 1	Restart 2	Restart 3	Idle N: Ruf Stalls	Idle Dr: Ruf Stalls
1														
1	2 3 4	5 6 7	8	9	10 11 12	13 14 15 16	17 18	19 20	21 22 23	24 25 26	27 28 29	30 31 32	33 34 35	36 37 38

	0.0 0-25 Lt. Th	0.1 25 Cruise	0.2 25-35 Detent	0.3 0-35 WOT	0.4 10-25 Lt. Th	0.5 Idle
	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Ruf Stalls
	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60 61 62	63 64 65 66 67 68	69 70
Card 2 Run No	0.5	0.6	0.7	0.8	0.9	1.0
1 2 3 4	5 6 7 8 9 10	11 12 13 14 15 16	17 18 19 20 21 22	23 24 25 26 27 28	29 30 31 32 33 34	35 36
	1.0	1.1	1.2	1.3	1.4	1.5
	37 38 39 40 41 42	43 44 45 46 47 48	49 50 51 52 53 54	55 56 57 58 59 60	61 62 63 64 65 66	67 68

	1.5 0-45 Crowd	1.9 25-35 Detent	2.0 0-35 WOT	2.1 10-25 Lt. Th.	2.2 Idle	
	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Hes Stm Stg Bkf Stalls Ac Dc	Ruf Stalls	
Card 3 Run No 1 2 3 4	5 6 7 8 9 10	11 12 13 14 15 16	17 18 19 20 21 22	23 24 25 26 27 28	29 30	
	2.2	2.6	2.7	2.8	2.9	
	31 32 33 34 35 36	37 38 39 40 41 42	43 44 45 46 47 48	49 50 51 52 53 54	55 56	
Card 4 Run No	2.9	3.3	3.4	3.5	3.6	C for Comment
1 2 3 4	5 6 7 8 9 10	11 12 13 14 15 16	17 18 19 20 21 22	23 24 25 26 27 28	29 30	31
	3.6	4.0	4.1	4.2	4.3	
	4.3	4.7	4.1	4.1	5.0	

~~Comments:~~

DEMERIT CALCULATION SYSTEM

A numerical value for driveability during the CRC test is obtained by assigning demerits to operating malfunctions as shown in Table IV. Depending upon the type of malfunction, demerits are assigned in various ways. Demerits for poor starting are obtained by subtracting two seconds from the measured starting time. The number of stalls which occur during idle as well as during driving maneuvers are counted separately and assigned demerits as shown in Table C-V. The multiplying factors of 8 and 32 for idle and maneuvering stalls, respectively, account for the fact that stalls are very undesirable, especially during car maneuvers.

Other malfunctions, such as hesitation, stumble, surge, idle roughness, and backfire, are rated subjectively by the driver on a scale of trace, moderate, or heavy. For these malfunctions, a certain number of demerits is assigned to each of the subjective ratings. However, since all malfunctions are not of equal importance, the demerits are multiplied by the weighting factors shown in Table C-V to yield weighted demerits.

Finally, weighted demerits, demerits for stalls, and demerits for poor starting are summed to obtain total weighted demerits (TWD), which are used as an indication of driveability during the test. As driveability deteriorates, TWD increases.

A Restriction has been applied in the totaling of demerits to insure that a stall results in the highest possible number of demerits within a given maneuver. When more than one malfunction occurs during a maneuver, demerits are counted for only the malfunction which had the largest number of weighted demerits. Another restriction was that for each idle period, no more than 3 idle stalls were counted.

TABLE C-V

METHOD FOR CALCULATING TOTAL WEIGHTED DEMERITS (TWD)

Demerits for Poor Starting:

Demerits = Starting Time(s) - 2

Demerits for Stalls:

Demerits = (No. of Idle Stalls) x 8 + (No. of Maneuvering Stalls) x 32

Demerits for Malfunctions Rated Subjectively:

Demerits for Subjective Ratings

Trace	=	1
Moderate	=	2
Heavy	=	4

Weighting Factors for Each Malfunction

Idle Roughness	=	1
Surge	=	4
Backfire, Stumble, Hesitation	=	6

Weighted Demerits = Demerits x Weighting Factor

Calculation:

Total Weighted Demerits = Weighted Demerits + Demerits for Stalls + Demerits for Poor Starting

Note: When more than one malfunction occurs in a driving maneuver, only the malfunction giving the highest weighted demerits is counted.

APPENDIX D

INDIVIDUAL LABORATORY

FUEL PROPERTY DATA

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 1

	LAB A	LAB B	LAB C	LAB D
RVP, psi	8.7	8.5	8.9	8.3
D86 DISTILLATION, °F				
% EVAP				
IBP	69	84	87	89
5	114	106	117	115
10	141	124	136	140
20	179	164	174	179
30	210	197	206	210
40	233	218	230	232
50	253	238	251	252
60	274	260	273	274
70	297	285	297	297
80	320	311	320	319
90	344	334	343	343
95	378	362	376	379
EP	433	419	444	440
% 158	-	19	16	-
T v/l= 5, °F	132	-	-	143
T v/l=10, °F	140	-	-	151
T v/l=15, °F	146	-	-	158
T v/l=20, °F	152	-	-	164
GRAVITY, API	55.6	56.1	-	56.0
RON	-	-	93	-
MON	-	-	84	-
ALCOHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 2

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.0	10.4	11.1	10.1
D86 DISTILLATION, °F				
% EVAP				
IBP	75	86	83	82
5	102	102	103	102
10	122	121	118	121
20	153	150	149	153
30	182	180	181	183
40	205	203	203	206
50	221	216	220	222
60	235	228	233	231
70	250	244	248	249
80	274	268	272	273
90	318	308	322	320
95	361	352	355	356
EP	419	406	416	420
% 158	-	23	23	-
T v/l= 5, °F	119	-	-	117
T v/l=10, °F	124	-	-	124
T v/l=15, °F	128	-	-	130
T v/l=20, °F	132	-	-	135
GRAVITY, API	64.0	64.7	-	64.5
RON	-	-	93	-
MON	-	-	86	-
ALCOHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 3

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.1	8.7	9.1	8.3
D86 DISTILLATION, °F				
% EVAP				
IBP	108	106	102	95
5	114	123	121	116
10	127	119	126	127
20	132	143	137	140
30	166*	198	200	198
40	219	232	229	230
50	247	247	250	250
60	269	267	274	273
70	294	295	296	296
80	317	316	319	319
90	334	335	342	342
95	368	370	373	375
EP	442	421	442	441
% 158	-	23	23	-
T v/l= 5, °F	123	-	-	124
T v/l=10, °F	125	-	-	127
T v/l=15, °F	127	-	-	130
T v/l=20, °F	129	-	-	132
GRAVITY, API	53.1	53.7	-	54.4
RON	-	-	95	-
MON	-	-	85	-
ALCOHOL CONTENT, V%				
MEOH	9.3	4.3	-	5.7
GTBA	-	-	-	-
ETOH	-	-	-	-

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* Suspect

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 4

	LAB A	LAB B	LAB C	LAB D
RVP, psi	-	10.9	11.3	10.6
D86 DISTILLATION, °F				
% EVAP				
IBP	-	97	93	93
5	-	114	113	108
10	-	112	118	118
20	-	123	125	126
30	-	170	167	145
40	-	206	202	196
50	-	218	217	219
60	-	226	234	232
70	-	245	249	250
80	-	272	272	273
90	-	313	321	320
95	-	356	351	350
EP	-	401	423	421
% 158	-	27	29	-
T v/l= 5, °F	-	-	-	115
T v/l=10, °F	-	-	-	118
T v/l=15, °F	-	-	-	120
T v/l=20, °F	-	-	-	122
GRAVITY, API	-	61.8	-	61.6
RON	-	-	96	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	-	3.9	-	6.6
GTBA	-	-	-	-
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 5

	LAB A	LAB B	LAB C	LAB D
RVP, psi	-	8.9	9.1	8.3
D86 DISTILLATION, °F				
% EVAP				
IBP	-	106	106	106
5	-	119	123	121
10	-	125	128	129
20	-	132	134	135
30	-	135	137	139
40	-	218	212	201
50	-	244	243	242
60	-	264	265	264
70	-	288	293	291
80	-	315	317	316
90	-	338	341	341
95	-	376	369	374
EP	-	408	431	446
% 158	-	32	34	-
T v/l= 5, °F	-	-	-	127
T v/l=10, °F	-	-	-	131
T v/l=15, °F	-	-	-	132
T v/l=20, °F	-	-	-	134
GRAVITY, API	-	53.3	-	53.6
RON	-	-	98	-
MON	-	-	86	-
ALCOHOL CONTENT, V%				
MEOH	-	9.0	-	12.2
GTBA	-	-	-	-
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 6

	LAB A	LAB B	LAB C	LAB D
RVP, psi	-	10.9	11.3	10.5
D86 DISTILLATION, °F				
% EVAP				
IBP	-	97	95	92
5	-	113	113	108
10	-	114	118	118
20	-	125	126	128
30	-	169*	134	133
40	-	206	195	144*
50	-	218	217	206
60	-	226	227	231
70	-	246	239	247
80	-	273	271	270
90	-	317	320	317
95	-	362	352	348
EP	-	401	416	429
% 158	-	28	33	-
T v/l= 5, °F	-	-	-	118
T v/l=10, °F	-	-	-	121
T v/l=15, °F	-	-	-	123
T v/l=20, °F	-	-	-	125
GRAVITY, API	-	61.7	-	60.7
RON	-	-	98	-
MON	-	-	88	-
ALCOHOL CONTENT, V%				
MEOH	-	6.0	-	12.0
GTBA	-	-	-	-
ETOH	-	-	-	-

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* Suspect

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 7

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.4	8.8	9.4	8.6
D86 DISTILLATION, °F				
% EVAP				
IBP	101	99	92	73
5	115	115	122	105
10	133	137	133	131
20	149	142	149	148
30	157	157	157	160
40	204	204	205	204
50	242	244	243	241
60	265	264	264	265
70	290	287	291	290
80	315	315	317	315
90	335	337	340	341
95	367	368	372	378
EP	440	417	441	442
% 158	-	30	30	-
T v/l= 5, °F	124	-	-	134
T v/l=10, °F	129	-	-	136
T v/l=15, °F	132	-	-	137
T v/l=20, °F	135	-	-	139
GRAVITY, API	54.6	55.2	-	55.5
RON	-	-	96	-
MON	-	-	86	-
ALCOHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	8.4	9.2	-	8.7

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 8

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.5	10.8	11.4	10.6
D86 DISTILLATION, °F				
% EVAP				
IBP	87	91	91	89
5	102	112	113	100
10	121	121	122	121
20	139	139	138	138
30	150	145	149	150
40	164	162	160	162
50	209	204	210	202
60	229	235	229	229
70	246	241	245	246
80	269	267	269	269
90	310	319	318	317
95	351	351	354	364
EP	426	414	420	422
% 158	-	38	39	-
T v/l= 5, °F	113	-	-	122
T v/l=10, °F	117	-	-	126
T v/l=15, °F	120	-	-	130
T v/l=20, °F	123	-	-	131
GRAVITY, API	62.2	62.6	-	62.5
RON	-	-	97	-
MON	-	-	89	-
ALCCHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	8.6	9.7	-	9.5

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 9

	LAB A	LAB B	LAB C	LAB D
RVP, psi	8.7	8.5	9.0	8.3
D86 DISTILLATION, °F				
% EVAP				
IBP	98	102	99	89
5	118	120	126	113
10	137	135	137	134
20	153	149	152	151
30	160	155	159	160
40	163	159	163	164
50	179	170	173	176
60	247	245	252	242
70	282	279	282	280
80	311	307	311	308
90	331	330	337	336
95	360	366	366	368
EP	437	419	424	423
% 158	-	43	28	-
T v/l= 5, °F	126	-	-	135
T v/l=10, °F	130	-	-	139
T v/l=15, °F	133	-	-	141
T v/l=20, °F	136	-	-	144
GRAVITY, API	54.1	54.3	-	54.7
RON	-	-	98	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	15.9	18.3	-	17.9

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 10

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.3	10.7	11.1	10.3
D86 DISTILLATION, °F				
% EVAP				
IBP	94	91	91	89
5	104	113	114	107
10	125	124	125	124
20	143	140	142	142
30	154	152	152	153
40	160	153	158	159
50	162	160	161	162
60	196	188	179	183
70	237	229	238	230
80	262	260	261	259
90	300	298	310	307
95	363	344	347	347
EP	416	405	416	415
% 158	-	47	40	-
T v/l= 5, °F	114	-	-	124
T v/l=10, °F	118	-	-	129
T v/l=15, °F	122	-	-	132
T v/l=20, °F	124	-	-	135
GRAVITY, API	60.3	60.8	-	61.2
RON	-	-	100	-
MON	-	-	89	-
ALCOHOL CONTENT, V%				
MEOH	-	-	-	-
GTBA	-	-	-	-
ETOH	16.6	18.8	-	18.5

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 11

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.1	8.7	9.1	8.3
D86 DISTILLATION, °F				
% EVAP				
IBP	96	97	101	99
5	119	118	120	116
10	129	126	128	128
20	146	145	144	144
30	182	179	178	177
40	215	214	212	211
50	245	240	242	241
60	268	263	266	264
70	292	289	292	291
80	317	315	316	314
90	338	337	340	339
95	366	368	368	369
EP	440	421	431	432
% 158	-	24	25	-
T v/l= 5, °F	122	-	-	143
T v/l=10, °F	126	-	-	146
T v/l=15, °F	129	-	-	148
T v/l=20, °F	131	-	-	151
GRAVITY, API	53.8	54.2	-	54.7
RON	-	-	95	-
MON	-	-	86	-
ALCOHOL CONTENT, V%				
MEOH	5.0	4.9	-	4.5
GTBA	4.9	5.0	-	4.8
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 12

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.4	10.6	11.1	10.4
D86 DISTILLATION, °F				
% EVAP				
IBP	91	95	93	89
5	102	111	113	104
10	118	119	120	118
20	134	134	134	134
30	160	159	158	158
40	189	187	189	187
50	214	210	213	213
60	233	227	232	233
70	249	242	250	249
80	272	268	272	273
90	309	314	320	319
95	360	351	354	353
EP	426	392	423	427
% 158	-	29.6	30	-
T v/l= 5, °F	113	-	-	124
T v/l=10, °F	116	-	-	128
T v/l=15, °F	118	-	-	130
T v/l=20, °F	121	61	-	132
GRAVITY, API	60.9	54.2	-	61.6
RON	-	-	95	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	4.3	4.8	-	4.3
GTBA	4.7	5.0	-	5.0
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 13

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.1	8.6	9.2	8.6
D86 DISTILLATION, °F				
% EVAP				
IBP	98	100	103	86
5	110	119	125	110
10	129	128	133	129
20	141	139	143	142
30	152	149	154	153
40	172	170	175	173
50	205	208	209	207
60	249	249	252	252
70	282	281	284	283
80	309	305	312	309
90	330	332	337	336
95	359	363	360	369
EP	433	405	430	438
% 158	-	34	33	-
T v/l= 5, °F	122	-	-	130
T v/l=10, °F	126	-	-	133
T v/l=15, °F	129	-	-	135
T v/l=20, °F	131	-	-	137
GRAVITY, API	53.5	53.7	-	54.3
RON	-	-	98	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	9.7	9.6	-	8.8
GTBA	9.9	9.8	-	9.6
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 14

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.3	10.4	11.0	10.4
D86 DISTILLATION, °F				
% EVAP				
IBP	90	95	97	95
5	100	113	118	112
10	120	120	125	124
20	134	135	136	136
30	144	142	145	146
40	157	153	158	159
50	177	181	180	180
60	211	210	212	211
70	240	232	239	241
80	264	264	267	265
90	302	316	316	311
95	347	355	350	343
EP	418	406	417	407
% 158	-	42	40	-
T v/l= 5, °F	114	-	-	134
T v/l=10, °F	117	-	-	138
T v/l=15, °F	120	-	-	140
T v/l=20, °F	122	-	-	142
GRAVITY, API	60.0	60.0	-	60.2
RON	-	-	98	-
MON	-	-	89	-
ALCOHOL CONTENT, V%				
MEOH	10.0	9.7	-	9.3
GTBA	9.9	11.3	-	9.7
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 15

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.2	8.9	9.1	8.4
D86 DISTILLATION, °F				
% EVAP				
IBP	101	104	102	102
5	114	119	122	116
10	128	123	128	127
20	137	135	137	138
30	182	180	183	181
40	221	222	220	220
50	246	243	244	245
60	269	262	267	268
70	294	291	293	293
80	317	312	317	316
90	337	336	341	341
95	370	374	369	374
EP	446	415	434	432
% 158	-	25	26	-
T v/l= 5, °F	121	-	-	135
T v/l=10, °F	125	-	-	138
T v/l=15, °F	127	-	-	140
T v/l=20, °F	128	-	-	142
GRAVITY, API	53.8	54.0	-	54.2
RON	-	-	100	-
MON	-	-	85	-
ALCOHOL CONTENT, V%				
MEOH	6.8	6.6	-	6.1
GTBA	2.2	2.4	-	2.3
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 16

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.6	10.9	11.2	10.6
D86 DISTILLATION, °F				
% EVAP				
IBP	92	93	94	94
5	100	108	113	105
10	116	115	119	116
20	126	124	129	128
30	152	154	163	151
40	192	193	199	190
50	218	218	216	214
60	233	229	232	233
70	249	245	251	247
80	271	275	274	271
90	308	314	323	317
95	355	353	354	352
EP	424	414	424	422
% 158	-	31	29	-
T v/l= 5, °F	110	-	-	122
T v/l=10, °F	113	-	-	123
T v/l=15, °F	115	-	-	125
T v/l=20, °F	117	-	-	127
GRAVITY, API	61.0	61.6	-	61.5
RON	-	-	95	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	6.3	5.0	-	6.2
GTBA	1.8	1.9	-	2.0
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 17

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.2	8.9	9.0	8.4
D86 DISTILLATION, °F				
% EVAP				
IBP	101	106	106	105
5	112	115	126	118
10	127	127	131	128
20	136	133	137	137
30	141	139	144	143
40	173	177	188	176
50	226	227	236	227
60	258	260	260	258
70	285	280	289	286
80	312	310	315	313
90	333	336	338	338
95	364	359	367	372
EP	437	410	430	425
% 158	-	35	34	-
T v/l= 5, °F	121	-	-	128
T v/l=10, °F	124	-	-	130
T v/l=15, °F	126	-	-	132
T v/l=20, °F	127	-	-	133
GRAVITY, API	53.4	53.6	-	53.7
RON	-	-	98	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	12.4	12.3	-	11.4
GTBA	3.3	3.5	-	3.4
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 18

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.6	10.9	11.1	10.4
D86 DISTILLATION, °F				
% EVAP				
IBP	91	97	95	93
5	101	114	111	108
10	118	116	118	119
20	129	129	128	130
30	136	131	135	137
40	144	146	144	146
50	186	190	189	188
60	224	228	223	223
70	244	240	243	243
80	265	264	263	268
90	305	313	316	315
95	347	345	350	348
EP	422	408	416	423
% 158	-	42	45	-
T v/l= 5, °F	112	-	-	127
T v/l=10, °F	115	-	-	130
T v/l=15, °F	117	-	-	130
T v/l=20, °F	118	-	-	132
GRAVITY, API	59.9	60.6	-	60.4
RON	-	-	98	-
MON	-	-	88	-
ALCOHOL CONTENT, V%				
MEOH	12.9	12.4	-	11.1
GTBA	3.4	3.5	-	3.4
ETOH	-	-	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 19

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.2	8.7	9.2	8.4
D86 DISTILLATION, °F				
% EVAP				
IBP	96	100	101	102
5	120	119	121	118
10	130	126	128	129
20	141	137	140	141
30	177	177	174	177
40	227	221	221	223
50	248	245	244	247
60	270	262	269	271
70	295	288	294	294
80	318	312	317	317
90	342	335	341	341
95	370	368	368	374
EP	443	412	434	436
% 158	-	25	28	-
T v/l= 5, °F	122	-	-	129
T v/l=10, °F	125	-	-	132
T v/l=15, °F	128	-	-	134
T v/l=20, °F	129	-	-	136
GRAVITY, API	53.8	54.3	-	54.1
RON	-	-	96	-
MON	-	-	86	-
ALCOHOL CONTENT, V%				
MEOH	4.6	4.6	-	4.0
GTBA	-	-	-	-
ETOH	3.3	3.7	-	-

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 20

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.4	10.6	11.0	10.1
D86 DISTILLATION, °F				
% EVAP				
IBP	94	95	94	93
5	102	109	114	108
10	118	121	121	120
20	131	126	132	132
30	142	148	143	143
40	184	189	189	185
50	217	219	217	215
60	231	230	231	231
70	247	243	247	248
80	270	373	270	271
90	306	322	320	318
95	364	365	353	349
EP	429	414	424	427
% 158	-	33	35	-
T v/l= 5, °F	113	-	-	134
T v/l=10, °F	116	-	-	137
T v/l=15, °F	118	-	-	139
T v/l=20, °F	120	-	-	141
GRAVITY, API	61.1	61.7	-	62.0
RON	-	-	96	-
MON	-	-	88	-
ALCOHOL CONTENT, V%				
MEOH	4.9	5.3	-	4.2
GTBA	-	-	-	-
ETOH	3.9	4.4	-	3.8

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 21

	LAB A	LAB B	LAB C	LAB D
RVP, psi	9.2	8.6	9.1	8.0
D86 DISTILLATION, °F				
% EVAP				
IBP	98	104	103	112
5	109	122	121	127
10	126	122	127	133
20	133	135	135	160
30	179	187	190	209
40	223	230	226	233
50	246	247	246	255
60	268	263	271	276
70	293	293	296	300
80	317	315	319	321
90	335	335	342	343
95	365	372	371	377
EP	435	417	439	442
% 158	-	24	25	-
T v/l= 5, °F	122	-	-	136
T v/l=10, °F	124	-	-	139
T v/l=15, °F	126	-	-	141
T v/l=20, °F	128	-	-	142
GRAVITY, API	53.5	53.7	-	53.8
RON	-	-	96	-
MON	-	-	85	-
ALCOHOL CONTENT, V%				
MEOH	6.3	5.6	-	5.4
GTBA	-	-	-	-
ETOH	1.4	1.4	-	1.5

APPENDIX D

INDIVIDUAL LABORATORY DATA

FUEL 22

	LAB A	LAB B	LAB C	LAB D
RVP, psi	11.4	10.6	11.0	10.1
D86 DISTILLATION, °F				
% EVAP				
IBP	92	95	93	94
5	103	111	113	110
10	119	117	120	119
20	128	124	129	129
30	149	154	151	148
40	194	194	200	197
50	219	221	219	219
60	234	228	229	233
70	249	238	251	249
80	273	273	273	273
90	310	316	321	319
95	349	351	354	349
EP	427	412	422	427
% 158	-	31	31	-
T v/l= 5, °F	112	-	-	116
T v/l=10, °F	115	-	-	119
T v/l=15, °F	117	-	-	121
T v/l=20, °F	119	-	-	123
GRAVITY, API	61.0	61.7	-	60.9
RON	-	-	96	-
MON	-	-	87	-
ALCOHOL CONTENT, V%				
MEOH	6.0	4.2	-	4.7
GTBA	-	-	-	-
ETOH	1.8	1.5	-	1.7

APPENDIX E

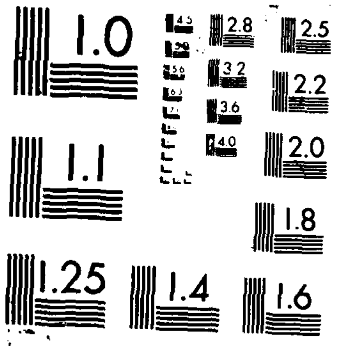
SUMMARY OF RAW DATA

SUBPROGRAM A

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
1	13	I	LOW	1	1	NONE	0.0	NONE	0
1	35	II	LOW	1	1	NONE	0.0	NONE	0
2	22	I	LOW	1	1	NONE	0.0	NONE	0
2	26	II	LOW	1	1	NONE	0.0	NONE	0
3	53	I	LOW	1	1	NONE	0.0	NONE	0
3	77	II	LOW	1	1	NONE	0.0	NONE	0
4	97	I	LOW	1	1	NONE	0.0	NONE	0
4	99	II	LOW	1	1	NONE	0.0	NONE	0
5	54	I	LOW	1	1	NONE	0.0	NONE	0
5	72	II	LOW	1	1	NONE	0.0	NONE	0
6	97	I	LOW	1	1	NONE	0.0	NONE	0
6	66	II	LOW	1	1	NONE	0.0	NONE	0
7	74	I	LOW	1	1	NONE	0.0	NONE	0
7	50	II	LOW	1	1	NONE	0.0	NONE	0
8	26	I	LOW	1	1	NONE	0.0	NONE	0
8	13	II	LOW	1	1	NONE	0.0	NONE	0
9	3	I	LOW	1	1	NONE	0.0	NONE	0
9	7	II	LOW	1	1	NONE	0.0	NONE	0
10	51	I	LOW	1	1	NONE	0.0	NONE	0
10	41	II	LOW	1	1	NONE	0.0	NONE	0
11	184	I	LOW	1	1	NONE	0.0	NONE	0
11	233	II	LOW	1	1	NONE	0.0	NONE	0
12	39	I	LOW	1	1	NONE	0.0	NONE	0
12	25	II	LOW	1	1	NONE	0.0	NONE	0
1	68	I	LOW	3	3	MEOH	3.5	NONE	0
1	49	II	LOW	3	3	MEOH	3.5	NONE	0
2	47	I	LOW	3	3	MEOH	3.5	NONE	0
2	66	II	LOW	3	3	MEOH	3.5	NONE	0
3	145	I	LOW	3	3	MEOH	3.5	NONE	0
3	142	II	LOW	3	3	MEOH	3.5	NONE	0
4	112	I	LOW	3	3	MEOH	3.5	NONE	0
4	[illegible]	II	LOW	3	3	MEOH	3.5	NONE	0
5	37	I	LOW	3	3	MEOH	3.5	NONE	[illegible]
5	55	II	LOW	3	3	MEOH	3.5	NONE	[illegible]
6	117	I	LOW	3	3	MEOH	3.5	NONE	[illegible]
6	148	II	LOW	3	3	MEOH	3.5	NONE	[illegible]
7	72	I	LOW	3	3	MEOH	3.5	NONE	[illegible]
7	116	II	LOW	3	3	MEOH	3.5	NONE	[illegible]
8	42	I	LOW	3	3	MEOH	3.5	[illegible]	[illegible]
8	53	II	LOW	3	3	MEOH	3.5	[illegible]	[illegible]
9	[illegible]	I	LOW	3	3	MEOH	[illegible]	[illegible]	[illegible]
9	[illegible]	II	LOW	3	3	MEOH	[illegible]	[illegible]	[illegible]
10	57	I	LOW	3	3	MEOH	[illegible]	[illegible]	[illegible]
10	[illegible]	II	LOW	3	3	MEOH	[illegible]	[illegible]	[illegible]
11	257	I	LOW	3	3	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	II	LOW	3	3	[illegible]	[illegible]	[illegible]	[illegible]
12	31	I	LOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	12	II	LOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	II	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	61	III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

AD-A188 330 1984 CRC (COORDINATING RESEARCH COUNCIL) INTERMEDIATE TEMPERATURE DRIVEAB..(U) COORDINATING RESEARCH COUNCIL INC ATLANTA GA AUG 87 CRC-554 2/2

UNCLASSIFIED F/G 21/4 NL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2.8
2.5
3.2
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1.25
1.4
1.6

SUBPROGRAM A

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
2	75	I	LOW	5	5	MEOH	7.0	NONE	0
2	56	II	LOW	5	5	MEOH	7.0	NONE	0
2	36	III	LOW	5	5	MEOH	7.0	NONE	0
3	182	I	LOW	5	5	MEOH	7.0	NONE	0
3	149	II	LOW	5	5	MEOH	7.0	NONE	0
3	208	III	LOW	5	5	MEOH	7.0	NONE	0
4	206	I	LOW	5	5	MEOH	7.0	NONE	0
4	196	II	LOW	5	5	MEOH	7.0	NONE	0
4	156	III	LOW	5	5	MEOH	7.0	NONE	0
5	66	I	LOW	5	5	MEOH	7.0	NONE	0
5	33	II	LOW	5	5	MEOH	7.0	NONE	0
5	55	III	LOW	5	5	MEOH	7.0	NONE	0
6	120	I	LOW	5	5	MEOH	7.0	NONE	0
6	127	II	LOW	5	5	MEOH	7.0	NONE	0
6	169	III	LOW	5	5	MEOH	7.0	NONE	0
7	153	I	LOW	5	5	MEOH	7.0	NONE	0
7	167	II	LOW	5	5	MEOH	7.0	NONE	0
7	142	III	LOW	5	5	MEOH	7.0	NONE	0
8	103	I	LOW	5	5	MEOH	7.0	NONE	0
8	44	II	LOW	5	5	MEOH	7.0	NONE	0
8	25	III	LOW	5	5	MEOH	7.0	NONE	0
9	51	I	LOW	5	5	MEOH	7.0	NONE	0
9	3	II	LOW	5	5	MEOH	7.0	NONE	0
9	25	III	LOW	5	5	MEOH	7.0	NONE	0
10	38	I	LOW	5	5	MEOH	7.0	NONE	0
10	68	II	LOW	5	5	MEOH	7.0	NONE	0
10	44	III	LOW	5	5	MEOH	7.0	NONE	0
11	390	I	LOW	5	5	MEOH	7.0	NONE	0
11	350	II	LOW	5	5	MEOH	7.0	NONE	0
11	388	III	LOW	5	5	MEOH	7.0	NONE	0
12	91	I	LOW	5	5	MEOH	7.0	NONE	0
12	80	II	LOW	5	5	MEOH	7.0	NONE	0
12	102	III	LOW	5	5	MEOH	7.0	NONE	0
1	81	I	LOW	7	7	ETOH	3.5	NONE	0
1	40	II	LOW	7	7	ETOH	3.5	NONE	0
2	33	I	LOW	7	7	ETOH	3.5	NONE	0
2	60	II	LOW	7	7	ETOH	3.5	NONE	0
3	91	I	LOW	7	7	ETOH	3.5	NONE	0
3	121	II	LOW	7	7	ETOH	3.5	NONE	0
4	92	I	LOW	7	7	ETOH	3.5	NONE	0
4	136	II	LOW	7	7	ETOH	3.5	NONE	0
5	43	I	LOW	7	7	ETOH	3.5	NONE	0
5	36	II	LOW	7	7	ETOH	3.5	NONE	0
6	113	I	LOW	7	7	ETOH	3.5	NONE	0
6	98	II	LOW	7	7	ETOH	3.5	NONE	0
7	44	I	LOW	7	7	ETOH	3.5	NONE	0
7	79	II	LOW	7	7	ETOH	3.5	NONE	0
8	44	I	LOW	7	7	ETOH	3.5	NONE	0
8	13	II	LOW	7	7	ETOH	3.5	NONE	0
9	53	I	LOW	7	7	ETOH	3.5	NONE	0
9	25	II	LOW	7	7	ETOH	3.5	NONE	0

SUBPROGRAM A

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
10	52	I	LOW	7	7	ETOH	3.5	NONE	0
10	54	II	LOW	7	7	ETOH	3.5	NONE	0
11	155	I	LOW	7	7	ETOH	3.5	NONE	0
11	263	II	LOW	7	7	ETOH	3.5	NONE	0
12	24	I	LOW	7	7	ETOH	3.5	NONE	0
12	18	II	LOW	7	7	ETOH	3.5	NONE	0
1	57	I	LOW	9	9	ETOH	7.0	NONE	0
1	35	II	LOW	9	9	ETOH	7.0	NONE	0
2	37	I	LOW	9	9	ETOH	7.0	NONE	0
2	52	II	LOW	9	9	ETOH	7.0	NONE	0
3	131	I	LOW	9	9	ETOH	7.0	NONE	0
3	119	II	LOW	9	9	ETOH	7.0	NONE	0
4	114	I	LOW	9	9	ETOH	7.0	NONE	0
4	120	II	LOW	9	9	ETOH	7.0	NONE	0
5	24	I	LOW	9	9	ETOH	7.0	NONE	0
5	46	II	LOW	9	9	ETOH	7.0	NONE	0
6	139	I	LOW	9	9	ETOH	7.0	NONE	0
6	165	II	LOW	9	9	ETOH	7.0	NONE	0
7	100	I	LOW	9	9	ETOH	7.0	NONE	0
7	84	II	LOW	9	9	ETOH	7.0	NONE	0
8	25	I	LOW	9	9	ETOH	7.0	NONE	0
8	23	II	LOW	9	9	ETOH	7.0	NONE	0
9	27	I	LOW	9	9	ETOH	7.0	NONE	0
9	1	II	LOW	9	9	ETOH	7.0	NONE	0
10	70	I	LOW	9	9	ETOH	7.0	NONE	0
10	46	II	LOW	9	9	ETOH	7.0	NONE	0
11	219	I	LOW	9	9	ETOH	7.0	NONE	0
11	325	II	LOW	9	9	ETOH	7.0	NONE	0
12	33	I	LOW	9	9	ETOH	7.0	NONE	0
12	74	II	LOW	9	9	ETOH	7.0	NONE	0
1	1	I	MED	2	1	NONE	0.0	NONE	0
1	37	II	MED	2	1	NONE	0.0	NONE	0
2	0	I	MED	2	1	NONE	0.0	NONE	0
2	8	II	MED	2	1	NONE	0.0	NONE	0
3	38	I	MED	2	1	NONE	0.0	NONE	0
3	27	II	MED	2	1	NONE	0.0	NONE	0
4	45	I	MED	2	1	NONE	0.0	NONE	0
4	49	II	MED	2	1	NONE	0.0	NONE	0
5	15	I	MED	2	1	NONE	0.0	NONE	0
5	26	II	MED	2	1	NONE	0.0	NONE	0
6	30	I	MED	2	1	NONE	0.0	NONE	0
6	35	II	MED	2	1	NONE	0.0	NONE	0
7	43	I	MED	2	1	NONE	0.0	NONE	0
7	2	II	MED	2	1	NONE	0.0	NONE	0
8	19	I	MED	2	1	NONE	0.0	NONE	0
8	3	II	MED	2	1	NONE	0.0	NONE	0
9	5	I	MED	2	1	NONE	0.0	NONE	0
9	1	II	MED	2	1	NONE	0.0	NONE	0
10	12	I	MED	2	1	NONE	0.0	NONE	0
10	12	II	MED	2	1	NONE	0.0	NONE	0
11	62	I	MED	2	1	NONE	0.0	NONE	0

SUBPROGRAM A

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
11	92	II	MED	2	1	NONE	0.0	NONE	0
12	14	I	MED	2	1	NONE	0.0	NONE	0
12	1	II	MED	2	1	NONE	0.0	NONE	0
1	24	I	MED	4	3	MEOH	3.5	NONE	0
1	33	II	MED	4	3	MEOH	3.5	NONE	0
2	2	I	MED	4	3	MEOH	3.5	NONE	0
2	3	II	MED	4	3	MEOH	3.5	NONE	0
3	55	I	MED	4	3	MEOH	3.5	NONE	0
3	51	II	MED	4	3	MEOH	3.5	NONE	0
4	50	I	MED	4	3	MEOH	3.5	NONE	0
4	74	II	MED	4	3	MEOH	3.5	NONE	0
5	15	I	MED	4	3	MEOH	3.5	NONE	0
5	29	II	MED	4	3	MEOH	3.5	NONE	0
6	21	I	MED	4	3	MEOH	3.5	NONE	0
6	57	II	MED	4	3	MEOH	3.5	NONE	0
7	42	I	MED	4	3	MEOH	3.5	NONE	0
7	34	II	MED	4	3	MEOH	3.5	NONE	0
8	15	I	MED	4	3	MEOH	3.5	NONE	0
8	16	II	MED	4	3	MEOH	3.5	NONE	0
9	6	I	MED	4	3	MEOH	3.5	NONE	0
9	1	II	MED	4	3	MEOH	3.5	NONE	0
10	31	I	MED	4	3	MEOH	3.5	NONE	0
10	36	II	MED	4	3	MEOH	3.5	NONE	0
11	185	I	MED	4	3	MEOH	3.5	NONE	0
11	181	II	MED	4	3	MEOH	3.5	NONE	0
12	13	I	MED	4	3	MEOH	3.5	NONE	0
12	15	II	MED	4	3	MEOH	3.5	NONE	0
1	19	I	MED	6	5	MEOH	7.0	NONE	0
1	40	II	MED	6	5	MEOH	7.0	NONE	0
2	22	I	MED	6	5	MEOH	7.0	NONE	0
2	12	II	MED	6	5	MEOH	7.0	NONE	0
3	47	I	MED	6	5	MEOH	7.0	NONE	0
3	106	II	MED	6	5	MEOH	7.0	NONE	0
4	45	I	MED	6	5	MEOH	7.0	NONE	0
4	101	II	MED	6	5	MEOH	7.0	NONE	0
5	28	I	MED	6	5	MEOH	7.0	NONE	0
5	33	II	MED	6	5	MEOH	7.0	NONE	0
6	88	I	MED	6	5	MEOH	7.0	NONE	0
6	94	II	MED	6	5	MEOH	7.0	NONE	0
7	76	I	MED	6	5	MEOH	7.0	NONE	0
7	87	II	MED	6	5	MEOH	7.0	NONE	0
8	41	I	MED	6	5	MEOH	7.0	NONE	0
8	51	II	MED	6	5	MEOH	7.0	NONE	0
9	3	I	MED	6	5	MEOH	7.0	NONE	0
9	1	II	MED	6	5	MEOH	7.0	NONE	0
10	32	I	MED	6	5	MEOH	7.0	NONE	0
10	44	II	MED	6	5	MEOH	7.0	NONE	0
11	258	I	MED	6	5	MEOH	7.0	NONE	0
11	265	II	MED	6	5	MEOH	7.0	NONE	0
12	19	I	MED	6	5	MEOH	7.0	NONE	0
12	36	II	MED	6	5	MEOH	7.0	NONE	0

SUBPROGRAM A

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI- CATE	VOLA- TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL- VENT	COSOL- VENT RATIO
1	27	I	MED	8	7	ETOH	3.5	NONE	0
1	37	II	MED	8	7	ETOH	3.5	NONE	0
2	4	I	MED	8	7	ETOH	3.5	NONE	0
2	13	II	MED	8	7	ETOH	3.5	NONE	0
3	29	I	MED	8	7	ETOH	3.5	NONE	0
3	27	II	MED	8	7	ETOH	3.5	NONE	0
4	53	I	MED	8	7	ETOH	3.5	NONE	0
4	56	II	MED	8	7	ETOH	3.5	NONE	0
5	22	I	MED	8	7	ETOH	3.5	NONE	0
5	16	II	MED	8	7	ETOH	3.5	NONE	0
6	59	I	MED	8	7	ETOH	3.5	NONE	0
6	68	II	MED	8	7	ETOH	3.5	NONE	0
7	41	I	MED	8	7	ETOH	3.5	NONE	0
7	17	II	MED	8	7	ETOH	3.5	NONE	0
8	29	I	MED	8	7	ETOH	3.5	NONE	0
8	32	II	MED	8	7	ETOH	3.5	NONE	0
9	4	I	MED	8	7	ETOH	3.5	NONE	0
9	2	II	MED	8	7	ETOH	3.5	NONE	0
10	6	I	MED	8	7	ETOH	3.5	NONE	0
10	13	II	MED	8	7	ETOH	3.5	NONE	0
11	101	I	MED	8	7	ETOH	3.5	NONE	0
11	141	II	MED	8	7	ETOH	3.5	NONE	0
12	26	I	MED	8	7	ETOH	3.5	NONE	0
12	7	II	MED	8	7	ETOH	3.5	NONE	0
1	32	I	MED	10	9	ETOH	7.0	NONE	0
1	30	II	MED	10	9	ETOH	7.0	NONE	0
2	4	I	MED	10	9	ETOH	7.0	NONE	0
2	10	II	MED	10	9	ETOH	7.0	NONE	0
3	45	I	MED	10	9	ETOH	7.0	NONE	0
3	44	II	MED	10	9	ETOH	7.0	NONE	0
4	62	I	MED	10	9	ETOH	7.0	NONE	0
4	51	II	MED	10	9	ETOH	7.0	NONE	0
5	16	I	MED	10	9	ETOH	7.0	NONE	0
5	20	II	MED	10	9	ETOH	7.0	NONE	0
6	60	I	MED	10	9	ETOH	7.0	NONE	0
6	43	II	MED	10	9	ETOH	7.0	NONE	0
7	40	I	MED	10	9	ETOH	7.0	NONE	0
7	35	II	MED	10	9	ETOH	7.0	NONE	0
8	47	I	MED	10	9	ETOH	7.0	NONE	0
8	18	II	MED	10	9	ETOH	7.0	NONE	0
9	5	I	MED	10	9	ETOH	7.0	NONE	0
9	0	II	MED	10	9	ETOH	7.0	NONE	0
10	32	I	MED	10	9	ETOH	7.0	NONE	0
10	12	II	MED	10	9	ETOH	7.0	NONE	0
11	196	I	MED	10	9	ETOH	7.0	NONE	0
11	237	II	MED	10	9	ETOH	7.0	NONE	0
12	24	I	MED	10	9	ETOH	7.0	NONE	0
12	19	II	MED	10	9	ETOH	7.0	NONE	0

SUBPROGRAM B

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
21	20	I	LOW	1	1	NONE	0.0	NONE	0.0
21	49	II	LOW	1	1	NONE	0.0	NONE	0.0
22	1	I	LOW	1	1	NONE	0.0	NONE	0.0
22	33	II	LOW	1	1	NONE	0.0	NONE	0.0
23	54	I	LOW	1	1	NONE	0.0	NONE	0.0
23	36	II	LOW	1	1	NONE	0.0	NONE	0.0
24	119	I	LOW	1	1	NONE	0.0	NONE	0.0
24	67	II	LOW	1	1	NONE	0.0	NONE	0.0
25	65	I	LOW	1	1	NONE	0.0	NONE	0.0
25	46	II	LOW	1	1	NONE	0.0	NONE	0.0
26	78	I	LOW	1	1	NONE	0.0	NONE	0.0
26	98	II	LOW	1	1	NONE	0.0	NONE	0.0
27	80	I	LOW	1	1	NONE	0.0	NONE	0.0
27	93	II	LOW	1	1	NONE	0.0	NONE	0.0
28	107	I	LOW	1	1	NONE	0.0	NONE	0.0
28	121	II	LOW	1	1	NONE	0.0	NONE	0.0
29	38	I	LOW	1	1	NONE	0.0	NONE	0.0
29	36	II	LOW	1	1	NONE	0.0	NONE	0.0
30	28	I	LOW	1	1	NONE	0.0	NONE	0.0
30	37	II	LOW	1	1	NONE	0.0	NONE	0.0
31	149	I	LOW	1	1	NONE	0.0	NONE	0.0
31	154	II	LOW	1	1	NONE	0.0	NONE	0.0
32	167	I	LOW	1	1	NONE	0.0	NONE	0.0
32	110	II	LOW	1	1	NONE	0.0	NONE	0.0
21	58	I	LOW	11	11	MEOH	3.5	TBA	0.5
21	64	II	LOW	11	11	MEOH	3.5	TBA	0.5
22	38	I	LOW	11	11	MEOH	3.5	TBA	0.5
22	33	II	LOW	11	11	MEOH	3.5	TBA	0.5
23	55	I	LOW	11	11	MEOH	3.5	TBA	0.5
23	82	II	LOW	11	11	MEOH	3.5	TBA	0.5
24	93	I	LOW	11	11	MEOH	3.5	TBA	0.5
24	110	II	LOW	11	11	MEOH	3.5	TBA	0.5
25	52	I	LOW	11	11	MEOH	3.5	TBA	0.5
25	101	II	LOW	11	11	MEOH	3.5	TBA	0.5
26	201	I	LOW	11	11	MEOH	3.5	TBA	0.5
26	134	II	LOW	11	11	MEOH	3.5	TBA	0.5
27	82	I	LOW	11	11	MEOH	3.5	TBA	0.5
27	84	II	LOW	11	11	MEOH	3.5	TBA	0.5
28	55	I	LOW	11	11	MEOH	3.5	TBA	0.5
28	188	II	LOW	11	11	MEOH	3.5	TBA	0.5
29	99	I	LOW	11	11	MEOH	3.5	TBA	0.5
29	55	II	LOW	11	11	MEOH	3.5	TBA	0.5
30	79	I	LOW	11	11	MEOH	3.5	TBA	0.5
30	90	II	LOW	11	11	MEOH	3.5	TBA	0.5
31	214	I	LOW	11	11	MEOH	3.5	TBA	0.5
31	257	II	LOW	11	11	MEOH	3.5	TBA	0.5
32	220	I	LOW	11	11	MEOH	3.5	TBA	0.5
32	79	II	LOW	11	11	MEOH	3.5	TBA	0.5
21	119	I	LOW	13	13	MEOH	7.0	TBA	0.5
21	111	II	LOW	13	13	MEOH	7.0	TBA	0.5
* 22	497	I	LOW	13	13	MEOH	7.0	TBA	0.5

* Deleted from average.

SUBPROGRAM B

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
22	37	II	LOW	13	13	MEOH	7.0	TBA	0.5
23	120	I	LOW	13	13	MEOH	7.0	TBA	0.5
23	107	II	LOW	13	13	MEOH	7.0	TBA	0.5
24	125	I	LOW	13	13	MEOH	7.0	TBA	0.5
24	210	II	LOW	13	13	MEOH	7.0	TBA	0.5
25	61	I	LOW	13	13	MEOH	7.0	TBA	0.5
25	68	II	LOW	13	13	MEOH	7.0	TBA	0.5
26	142	I	LOW	13	13	MEOH	7.0	TBA	0.5
26	155	II	LOW	13	13	MEOH	7.0	TBA	0.5
27	122	I	LOW	13	13	MEOH	7.0	TBA	0.5
27	106	II	LOW	13	13	MEOH	7.0	TBA	0.5
28	128	I	LOW	13	13	MEOH	7.0	TBA	0.5
28	105	II	LOW	13	13	MEOH	7.0	TBA	0.5
29	100	I	LOW	13	13	MEOH	7.0	TBA	0.5
29	41	II	LOW	13	13	MEOH	7.0	TBA	0.5
30	117	I	LOW	13	13	MEOH	7.0	TBA	0.5
30	102	II	LOW	13	13	MEOH	7.0	TBA	0.5
31	273	I	LOW	13	13	MEOH	7.0	TBA	0.5
31	187	II	LOW	13	13	MEOH	7.0	TBA	0.5
32	280	I	LOW	13	13	MEOH	7.0	TBA	0.5
32	225	II	LOW	13	13	MEOH	7.0	TBA	0.5
21	135	I	LOW	15	15	MEOH	3.5	TBA	0.2
21	92	II	LOW	15	15	MEOH	3.5	TBA	0.2
22	65	I	LOW	15	15	MEOH	3.5	TBA	0.2
22	27	II	LOW	15	15	MEOH	3.5	TBA	0.2
23	111	I	LOW	15	15	MEOH	3.5	TBA	0.2
23	61	II	LOW	15	15	MEOH	3.5	TBA	0.2
24	87	I	LOW	15	15	MEOH	3.5	TBA	0.2
24	149	II	LOW	15	15	MEOH	3.5	TBA	0.2
25	57	I	LOW	15	15	MEOH	3.5	TBA	0.2
25	53	II	LOW	15	15	MEOH	3.5	TBA	0.2
26	83	I	LOW	15	15	MEOH	3.5	TBA	0.2
26	121	II	LOW	15	15	MEOH	3.5	TBA	0.2
27	55	I	LOW	15	15	MEOH	3.5	TBA	0.2
27	108	II	LOW	15	15	MEOH	3.5	TBA	0.2
28	62	I	LOW	15	15	MEOH	3.5	TBA	0.2
28	144	II	LOW	15	15	MEOH	3.5	TBA	0.2
29	32	I	LOW	15	15	MEOH	3.5	TBA	0.2
29	145	II	LOW	15	15	MEOH	3.5	TBA	0.2
30	56	I	LOW	15	15	MEOH	3.5	TBA	0.2
30	104	II	LOW	15	15	MEOH	3.5	TBA	0.2
31	187	I	LOW	15	15	MEOH	3.5	TBA	0.2
31	125	II	LOW	15	15	MEOH	3.5	TBA	0.2
32	172	I	LOW	15	15	MEOH	3.5	TBA	0.2
32	201	II	LOW	15	15	MEOH	3.5	TBA	0.2
21	147	I	LOW	17	17	MEOH	7.0	TBA	0.2
21	73	II	LOW	17	17	MEOH	7.0	TBA	0.2
22	64	I	LOW	17	17	MEOH	7.0	TBA	0.2
22	34	II	LOW	17	17	MEOH	7.0	TBA	0.2
23	123	I	LOW	17	17	MEOH	7.0	TBA	0.2
23	117	II	LOW	17	17	MEOH	7.0	TBA	0.2

SUBPROGRAM B

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
24	200	I	LOW	17	17	MEOH	7.0	TBA	0.2
24	158	II	LOW	17	17	MEOH	7.0	TBA	0.2
25	73	I	LOW	17	17	MEOH	7.0	TBA	0.2
25	39	II	LOW	17	17	MEOH	7.0	TBA	0.2
26	116	I	LOW	17	17	MEOH	7.0	TBA	0.2
26	159	II	LOW	17	17	MEOH	7.0	TBA	0.2
27	136	I	LOW	17	17	MEOH	7.0	TBA	0.2
27	118	II	LOW	17	17	MEOH	7.0	TBA	0.2
28	103	I	LOW	17	17	MEOH	7.0	TBA	0.2
28	162	II	LOW	17	17	MEOH	7.0	TBA	0.2
29	51	I	LOW	17	17	MEOH	7.0	TBA	0.2
29	115	II	LOW	17	17	MEOH	7.0	TBA	0.2
30	108	I	LOW	17	17	MEOH	7.0	TBA	0.2
30	63	II	LOW	17	17	MEOH	7.0	TBA	0.2
31	198	I	LOW	17	17	MEOH	7.0	TBA	0.2
31	134	II	LOW	17	17	MEOH	7.0	TBA	0.2
32	252	I	LOW	17	17	MEOH	7.0	TBA	0.2
32	342	II	LOW	17	17	MEOH	7.0	TBA	0.2
21	112	I	MED	2	1	NONE	0.0	NONE	0.0
21	2	II	MED	2	1	NONE	0.0	NONE	0.0
22	9	I	MED	2	1	NONE	0.0	NONE	0.0
22	0	II	MED	2	1	NONE	0.0	NONE	0.0
23	32	I	MED	2	1	NONE	0.0	NONE	0.0
23	36	II	MED	2	1	NONE	0.0	NONE	0.0
24	55	I	MED	2	1	NONE	0.0	NONE	0.0
24	59	II	MED	2	1	NONE	0.0	NONE	0.0
25	40	I	MED	2	1	NONE	0.0	NONE	0.0
25	22	II	MED	2	1	NONE	0.0	NONE	0.0
26	25	I	MED	2	1	NONE	0.0	NONE	0.0
26	19	II	MED	2	1	NONE	0.0	NONE	0.0
27	24	I	MED	2	1	NONE	0.0	NONE	0.0
27	80	II	MED	2	1	NONE	0.0	NONE	0.0
28	66	I	MED	2	1	NONE	0.0	NONE	0.0
28	90	II	MED	2	1	NONE	0.0	NONE	0.0
29	33	I	MED	2	1	NONE	0.0	NONE	0.0
29	22	II	MED	2	1	NONE	0.0	NONE	0.0
30	25	I	MED	2	1	NONE	0.0	NONE	0.0
30	34	II	MED	2	1	NONE	0.0	NONE	0.0
31	103	I	MED	2	1	NONE	0.0	NONE	0.0
31	31	II	MED	2	1	NONE	0.0	NONE	0.0
32	111	I	MED	2	1	NONE	0.0	NONE	0.0
32	29	II	MED	2	1	NONE	0.0	NONE	0.0
21	106	I	MED	12	11	MEOH	3.5	TBA	0.5
21	20	II	MED	12	11	MEOH	3.5	TBA	0.5
22	0	I	MED	12	11	MEOH	3.5	TBA	0.5
22	0	II	MED	12	11	MEOH	3.5	TBA	0.5
23	30	I	MED	12	11	MEOH	3.5	TBA	0.5
23	45	II	MED	12	11	MEOH	3.5	TBA	0.5
24	61	I	MED	12	11	MEOH	3.5	TBA	0.5
24	62	II	MED	12	11	MEOH	3.5	TBA	0.5
25	34	I	MED	12	11	MEOH	3.5	TBA	0.5

SUBPROGRAM B

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
25	34	II	MED	12	11	MEOH	3.5	TBA	0.5
26	87	I	MED	12	11	MEOH	3.5	TBA	0.5
26	83	II	MED	12	11	MEOH	3.5	TBA	0.5
27	29	I	MED	12	11	MEOH	3.5	TBA	0.5
27	56	II	MED	12	11	MEOH	3.5	TBA	0.5
28	82	I	MED	12	11	MEOH	3.5	TBA	0.5
28	192	II	MED	12	11	MEOH	3.5	TBA	0.5
29	51	I	MED	12	11	MEOH	3.5	TBA	0.5
29	61	II	MED	12	11	MEOH	3.5	TBA	0.5
30	9	I	MED	12	11	MEOH	3.5	TBA	0.5
30	30	II	MED	12	11	MEOH	3.5	TBA	0.5
31	68	I	MED	12	11	MEOH	3.5	TBA	0.5
31	91	II	MED	12	11	MEOH	3.5	TBA	0.5
32	101	I	MED	12	11	MEOH	3.5	TBA	0.5
32	140	II	MED	12	11	MEOH	3.5	TBA	0.5
21	2	I	MED	14	13	MEOH	7.0	TBA	0.5
21	15	II	MED	14	13	MEOH	7.0	TBA	0.5
21	29	III	MED	14	13	MEOH	7.0	TBA	0.5
22	0	I	MED	14	13	MEOH	7.0	TBA	0.5
22	0	II	MED	14	13	MEOH	7.0	TBA	0.5
22	0	III	MED	14	13	MEOH	7.0	TBA	0.5
23	36	I	MED	14	13	MEOH	7.0	TBA	0.5
23	36	II	MED	14	13	MEOH	7.0	TBA	0.5
23	31	III	MED	14	13	MEOH	7.0	TBA	0.5
24	72	I	MED	14	13	MEOH	7.0	TBA	0.5
24	53	II	MED	14	13	MEOH	7.0	TBA	0.5
24	59	III	MED	14	13	MEOH	7.0	TBA	0.5
25	40	I	MED	14	13	MEOH	7.0	TBA	0.5
25	24	II	MED	14	13	MEOH	7.0	TBA	0.5
25	36	III	MED	14	13	MEOH	7.0	TBA	0.5
26	66	I	MED	14	13	MEOH	7.0	TBA	0.5
26	79	II	MED	14	13	MEOH	7.0	TBA	0.5
*26	268	III	MED	14	13	MEOH	7.0	TBA	0.5
27	135	I	MED	14	13	MEOH	7.0	TBA	0.5
27	79	II	MED	14	13	MEOH	7.0	TBA	0.5
27	113	III	MED	14	13	MEOH	7.0	TBA	0.5
28	84	I	MED	14	13	MEOH	7.0	TBA	0.5
28	88	II	MED	14	13	MEOH	7.0	TBA	0.5
28	84	III	MED	14	13	MEOH	7.0	TBA	0.5
29	56	I	MED	14	13	MEOH	7.0	TBA	0.5
29	25	II	MED	14	13	MEOH	7.0	TBA	0.5
29	38	III	MED	14	13	MEOH	7.0	TBA	0.5
30	18	I	MED	14	13	MEOH	7.0	TBA	0.5
30	82	II	MED	14	13	MEOH	7.0	TBA	0.5
30	44	III	MED	14	13	MEOH	7.0	TBA	0.5
31	181	I	MED	14	13	MEOH	7.0	TBA	0.5
31	135	II	MED	14	13	MEOH	7.0	TBA	0.5
31	140	III	MED	14	13	MEOH	7.0	TBA	0.5
32	174	I	MED	14	13	MEOH	7.0	TBA	0.5
32	148	II	MED	14	13	MEOH	7.0	TBA	0.5
32	234	III	MED	14	13	MEOH	7.0	TBA	0.5

* Deleted from average.

SUBPROGRAM B

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
21	46	I	MED	16	15	MEOH	3.5	TBA	0.2
21	21	II	MED	16	15	MEOH	3.5	TBA	0.2
22	0	I	MED	16	15	MEOH	3.5	TBA	0.2
22	0	II	MED	16	15	MEOH	3.5	TBA	0.2
23	44	I	MED	16	15	MEOH	3.5	TBA	0.2
23	31	II	MED	16	15	MEOH	3.5	TBA	0.2
24	77	I	MED	16	15	MEOH	3.5	TBA	0.2
24	116	II	MED	16	15	MEOH	3.5	TBA	0.2
25	28	I	MED	16	15	MEOH	3.5	TBA	0.2
25	28	II	MED	16	15	MEOH	3.5	TBA	0.2
26	89	I	MED	16	15	MEOH	3.5	TBA	0.2
26	61	II	MED	16	15	MEOH	3.5	TBA	0.2
27	95	I	MED	16	15	MEOH	3.5	TBA	0.2
27	68	II	MED	16	15	MEOH	3.5	TBA	0.2
28	97	I	MED	16	15	MEOH	3.5	TBA	0.2
28	120	II	MED	16	15	MEOH	3.5	TBA	0.2
29	52	I	MED	16	15	MEOH	3.5	TBA	0.2
29	51	II	MED	16	15	MEOH	3.5	TBA	0.2
30	31	I	MED	16	15	MEOH	3.5	TBA	0.2
30	27	II	MED	16	15	MEOH	3.5	TBA	0.2
31	120	I	MED	16	15	MEOH	3.5	TBA	0.2
31	72	II	MED	16	15	MEOH	3.5	TBA	0.2
32	151	I	MED	16	15	MEOH	3.5	TBA	0.2
32	117	II	MED	16	15	MEOH	3.5	TBA	0.2
21	73	I	MED	18	17	MEOH	7.0	TBA	0.2
21	38	II	MED	18	17	MEOH	7.0	TBA	0.2
22	0	I	MED	18	17	MEOH	7.0	TBA	0.2
22	0	II	MED	18	17	MEOH	7.0	TBA	0.2
23	49	I	MED	18	17	MEOH	7.0	TBA	0.2
23	41	II	MED	18	17	MEOH	7.0	TBA	0.2
24	71	I	MED	18	17	MEOH	7.0	TBA	0.2
24	58	II	MED	18	17	MEOH	7.0	TBA	0.2
25	44	I	MED	18	17	MEOH	7.0	TBA	0.2
25	30	II	MED	18	17	MEOH	7.0	TBA	0.2
26	91	I	MED	18	17	MEOH	7.0	TBA	0.2
26	67	II	MED	18	17	MEOH	7.0	TBA	0.2
27	65	I	MED	18	17	MEOH	7.0	TBA	0.2
27	94	II	MED	18	17	MEOH	7.0	TBA	0.2
28	82	I	MED	18	17	MEOH	7.0	TBA	0.2
28	110	II	MED	18	17	MEOH	7.0	TBA	0.2
29	27	I	MED	18	17	MEOH	7.0	TBA	0.2
29	58	II	MED	18	17	MEOH	7.0	TBA	0.2
30	12	I	MED	18	17	MEOH	7.0	TBA	0.2
30	34	II	MED	18	17	MEOH	7.0	TBA	0.2
31	111	I	MED	18	17	MEOH	7.0	TBA	0.2
31	61	II	MED	18	17	MEOH	7.0	TBA	0.2
32	221	I	MED	18	17	MEOH	7.0	TBA	0.2
32	128	II	MED	18	17	MEOH	7.0	TBA	0.2

SUBPROGRAM C

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
41	10	I	LOW	1	1	NONE	0.0	NONE	0.0
41	1	II	LOW	1	1	NONE	0.0	NONE	0.0
42	21	I	LOW	1	1	NONE	0.0	NONE	0.0
42	10	II	LOW	1	1	NONE	0.0	NONE	0.0
43	91	I	LOW	1	1	NONE	0.0	NONE	0.0
43	39	II	LOW	1	1	NONE	0.0	NONE	0.0
44	85	I	LOW	1	1	NONE	0.0	NONE	0.0
44	73	II	LOW	1	1	NONE	0.0	NONE	0.0
45	6	I	LOW	1	1	NONE	0.0	NONE	0.0
45	9	II	LOW	1	1	NONE	0.0	NONE	0.0
46	76	I	LOW	1	1	NONE	0.0	NONE	0.0
46	84	II	LOW	1	1	NONE	0.0	NONE	0.0
47	22	I	LOW	1	1	NONE	0.0	NONE	0.0
47	54	II	LOW	1	1	NONE	0.0	NONE	0.0
48	43	I	LOW	1	1	NONE	0.0	NONE	0.0
48	24	II	LOW	1	1	NONE	0.0	NONE	0.0
49	32	I	LOW	1	1	NONE	0.0	NONE	0.0
49	9	II	LOW	1	1	NONE	0.0	NONE	0.0
50	10	I	LOW	1	1	NONE	0.0	NONE	0.0
50	72	II	LOW	1	1	NONE	0.0	NONE	0.0
51	183	I	LOW	1	1	NONE	0.0	NONE	0.0
51	275	II	LOW	1	1	NONE	0.0	NONE	0.0
52	69	I	LOW	1	1	NONE	0.0	NONE	0.0
52	144	II	LOW	1	1	NONE	0.0	NONE	0.0
41	58	I	LOW	11	11	MEOH	3.5	TBA	0.5
41	26	II	LOW	11	11	MEOH	3.5	TBA	0.5
42	21	I	LOW	11	11	MEOH	3.5	TBA	0.5
42	43	II	LOW	11	11	MEOH	3.5	TBA	0.5
43	122	I	LOW	11	11	MEOH	3.5	TBA	0.5
43	118	II	LOW	11	11	MEOH	3.5	TBA	0.5
44	163	I	LOW	11	11	MEOH	3.5	TBA	0.5
44	103	II	LOW	11	11	MEOH	3.5	TBA	0.5
45	6	I	LOW	11	11	MEOH	3.5	TBA	0.5
45	35	II	LOW	11	11	MEOH	3.5	TBA	0.5
46	90	I	LOW	11	11	MEOH	3.5	TBA	0.5
46	156	II	LOW	11	11	MEOH	3.5	TBA	0.5
47	84	I	LOW	11	11	MEOH	3.5	TBA	0.5
47	109	II	LOW	11	11	MEOH	3.5	TBA	0.5
48	44	I	LOW	11	11	MEOH	3.5	TBA	0.5
48	48	II	LOW	11	11	MEOH	3.5	TBA	0.5
49	39	I	LOW	11	11	MEOH	3.5	TBA	0.5
49	31	II	LOW	11	11	MEOH	3.5	TBA	0.5
50	71	I	LOW	11	11	MEOH	3.5	TBA	0.5
50	138	II	LOW	11	11	MEOH	3.5	TBA	0.5
51	255	I	LOW	11	11	MEOH	3.5	TBA	0.5
51	323	II	LOW	11	11	MEOH	3.5	TBA	0.5
52	195	I	LOW	11	11	MEOH	3.5	TBA	0.5
52	186	II	LOW	11	11	MEOH	3.5	TBA	0.5
41	36	I	LOW	15	15	MEOH	3.5	TBA	0.2
41	44	II	LOW	15	15	MEOH	3.5	TBA	0.2
42	54	I	LOW	15	15	MEOH	3.5	TBA	0.2

SUBPROGRAM C

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
*42	437	II	LOW	15	15	MEOH	3.5	TBA	0.2
43	118	I	LOW	15	15	MEOH	3.5	TBA	0.2
43	130	II	LOW	15	15	MEOH	3.5	TBA	0.2
44	97	I	LOW	15	15	MEOH	3.5	TBA	0.2
44	124	II	LOW	15	15	MEOH	3.5	TBA	0.2
45	17	I	LOW	15	15	MEOH	3.5	TBA	0.2
45	11	II	LOW	15	15	MEOH	3.5	TBA	0.2
46	125	I	LOW	15	15	MEOH	3.5	TBA	0.2
46	147	II	LOW	15	15	MEOH	3.5	TBA	0.2
47	75	I	LOW	15	15	MEOH	3.5	TBA	0.2
47	100	II	LOW	15	15	MEOH	3.5	TBA	0.2
48	34	I	LOW	15	15	MEOH	3.5	TBA	0.2
48	71	II	LOW	15	15	MEOH	3.5	TBA	0.2
49	25	I	LOW	15	15	MEOH	3.5	TBA	0.2
49	38	II	LOW	15	15	MEOH	3.5	TBA	0.2
50	94	I	LOW	15	15	MEOH	3.5	TBA	0.2
50	104	II	LOW	15	15	MEOH	3.5	TBA	0.2
51	379	I	LOW	15	15	MEOH	3.5	TBA	0.2
51	349	II	LOW	15	15	MEOH	3.5	TBA	0.2
52	157	I	LOW	15	15	MEOH	3.5	TBA	0.2
52	206	II	LOW	15	15	MEOH	3.5	TBA	0.2
41	48	I	LOW	19	19	MEOH	3.5	ETOH	0.5
41	66	II	LOW	19	19	MEOH	3.5	ETOH	0.5
42	25	I	LOW	19	19	MEOH	3.5	ETOH	0.5
*42	300	II	LOW	19	19	MEOH	3.5	ETOH	0.5
43	95	I	LOW	19	19	MEOH	3.5	ETOH	0.5
43	176	II	LOW	19	19	MEOH	3.5	ETOH	0.5
44	140	I	LOW	19	19	MEOH	3.5	ETOH	0.5
44	130	II	LOW	19	19	MEOH	3.5	ETOH	0.5
45	19	I	LOW	19	19	MEOH	3.5	ETOH	0.5
45	16	II	LOW	19	19	MEOH	3.5	ETOH	0.5
46	71	I	LOW	19	19	MEOH	3.5	ETOH	0.5
46	147	II	LOW	19	19	MEOH	3.5	ETOH	0.5
47	61	I	LOW	19	19	MEOH	3.5	ETOH	0.5
47	113	II	LOW	19	19	MEOH	3.5	ETOH	0.5
48	36	I	LOW	19	19	MEOH	3.5	ETOH	0.5
48	30	II	LOW	19	19	MEOH	3.5	ETOH	0.5
49	25	I	LOW	19	19	MEOH	3.5	ETOH	0.5
49	32	II	LOW	19	19	MEOH	3.5	ETOH	0.5
50	54	I	LOW	19	19	MEOH	3.5	ETOH	0.5
50	140	II	LOW	19	19	MEOH	3.5	ETOH	0.5
51	264	I	LOW	19	19	MEOH	3.5	ETOH	0.5
51	338	II	LOW	19	19	MEOH	3.5	ETOH	0.5
52	139	I	LOW	19	19	MEOH	3.5	ETOH	0.5
52	280	II	LOW	19	19	MEOH	3.5	ETOH	0.5
41	41	I	LOW	21	21	MEOH	3.5	ETOH	0.2
41	39	II	LOW	21	21	MEOH	3.5	ETOH	0.2
42	48	I	LOW	21	21	MEOH	3.5	ETOH	0.2
42	66	II	LOW	21	21	MEOH	3.5	ETOH	0.2
43	154	I	LOW	21	21	MEOH	3.5	ETOH	0.2
43	148	II	LOW	21	21	MEOH	3.5	ETOH	0.2

* Deleted from average.

SUBPROGRAM C

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
44	111	I	LOW	21	21	MEOH	3.5	ETOH	0.2
44	143	II	LOW	21	21	MEOH	3.5	ETOH	0.2
45	25	I	LOW	21	21	MEOH	3.5	ETOH	0.2
45	20	II	LOW	21	21	MEOH	3.5	ETOH	0.2
46	105	I	LOW	21	21	MEOH	3.5	ETOH	0.2
46	157	II	LOW	21	21	MEOH	3.5	ETOH	0.2
47	80	I	LOW	21	21	MEOH	3.5	ETOH	0.2
47	128	II	LOW	21	21	MEOH	3.5	ETOH	0.2
48	82	I	LOW	21	21	MEOH	3.5	ETOH	0.2
48	42	II	LOW	21	21	MEOH	3.5	ETOH	0.2
49	51	I	LOW	21	21	MEOH	3.5	ETOH	0.2
49	44	II	LOW	21	21	MEOH	3.5	ETOH	0.2
50	69	I	LOW	21	21	MEOH	3.5	ETOH	0.2
50	86	II	LOW	21	21	MEOH	3.5	ETOH	0.2
51	354	I	LOW	21	21	MEOH	3.5	ETOH	0.2
51	265	II	LOW	21	21	MEOH	3.5	ETOH	0.2
52	197	I	LOW	21	21	MEOH	3.5	ETOH	0.2
52	230	II	LOW	21	21	MEOH	3.5	ETOH	0.2
41	15	I	MED	2	1	NONE	0.0	NONE	0.0
41	2	II	MED	2	1	NONE	0.0	NONE	0.0
42	9	I	MED	2	1	NONE	0.0	NONE	0.0
42	0	II	MED	2	1	NONE	0.0	NONE	0.0
43	46	I	MED	2	1	NONE	0.0	NONE	0.0
43	30	II	MED	2	1	NONE	0.0	NONE	0.0
44	34	I	MED	2	1	NONE	0.0	NONE	0.0
44	34	II	MED	2	1	NONE	0.0	NONE	0.0
45	0	I	MED	2	1	NONE	0.0	NONE	0.0
45	0	II	MED	2	1	NONE	0.0	NONE	0.0
46	15	I	MED	2	1	NONE	0.0	NONE	0.0
46	26	II	MED	2	1	NONE	0.0	NONE	0.0
47	29	I	MED	2	1	NONE	0.0	NONE	0.0
47	31	II	MED	2	1	NONE	0.0	NONE	0.0
48	11	I	MED	2	1	NONE	0.0	NONE	0.0
48	19	II	MED	2	1	NONE	0.0	NONE	0.0
49	8	I	MED	2	1	NONE	0.0	NONE	0.0
49	6	II	MED	2	1	NONE	0.0	NONE	0.0
50	9	I	MED	2	1	NONE	0.0	NONE	0.0
50	86	II	MED	2	1	NONE	0.0	NONE	0.0
51	139	I	MED	2	1	NONE	0.0	NONE	0.0
51	179	II	MED	2	1	NONE	0.0	NONE	0.0
52	78	I	MED	2	1	NONE	0.0	NONE	0.0
52	150	II	MED	2	1	NONE	0.0	NONE	0.0
41	5	I	MED	12	11	MEOH	3.5	TBA	0.5
41	28	II	MED	12	11	MEOH	3.5	TBA	0.5
42	9	I	MED	12	11	MEOH	3.5	TBA	0.5
42	1	II	MED	12	11	MEOH	3.5	TBA	0.5
43	62	I	MED	12	11	MEOH	3.5	TBA	0.5
43	62	II	MED	12	11	MEOH	3.5	TBA	0.5
44	47	I	MED	12	11	MEOH	3.5	TBA	0.5
44	60	II	MED	12	11	MEOH	3.5	TBA	0.5
45	0	I	MED	12	11	MEOH	3.5	TBA	0.5

SUBPROGRAM C

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
45	1	II	MED	12	11	MEOH	3.5	TBA	0.5
46	70	I	MED	12	11	MEOH	3.5	TBA	0.5
46	41	II	MED	12	11	MEOH	3.5	TBA	0.5
47	39	I	MED	12	11	MEOH	3.5	TBA	0.5
47	23	II	MED	12	11	MEOH	3.5	TBA	0.5
48	40	I	MED	12	11	MEOH	3.5	TBA	0.5
48	26	II	MED	12	11	MEOH	3.5	TBA	0.5
49	12	I	MED	12	11	MEOH	3.5	TBA	0.5
49	24	II	MED	12	11	MEOH	3.5	TBA	0.5
50	49	I	MED	12	11	MEOH	3.5	TBA	0.5
50	104	II	MED	12	11	MEOH	3.5	TBA	0.5
51	276	I	MED	12	11	MEOH	3.5	TBA	0.5
51	305	II	MED	12	11	MEOH	3.5	TBA	0.5
52	65	I	MED	12	11	MEOH	3.5	TBA	0.5
52	158	II	MED	12	11	MEOH	3.5	TBA	0.5
41	2	I	MED	16	15	MEOH	3.5	TBA	0.2
41	38	II	MED	16	15	MEOH	3.5	TBA	0.2
41	23	III	MED	16	15	MEOH	3.5	TBA	0.2
42	33	I	MED	16	15	MEOH	3.5	TBA	0.2
42	17	II	MED	16	15	MEOH	3.5	TBA	0.2
42	1	III	MED	16	15	MEOH	3.5	TBA	0.2
43	48	I	MED	16	15	MEOH	3.5	TBA	0.2
43	66	II	MED	16	15	MEOH	3.5	TBA	0.2
43	62	III	MED	16	15	MEOH	3.5	TBA	0.2
44	82	I	MED	16	15	MEOH	3.5	TBA	0.2
44	44	II	MED	16	15	MEOH	3.5	TBA	0.2
44	34	III	MED	16	15	MEOH	3.5	TBA	0.2
45	0	I	MED	16	15	MEOH	3.5	TBA	0.2
45	0	II	MED	16	15	MEOH	3.5	TBA	0.2
45	0	III	MED	16	15	MEOH	3.5	TBA	0.2
46	58	I	MED	16	15	MEOH	3.5	TBA	0.2
46	70	II	MED	16	15	MEOH	3.5	TBA	0.2
46	49	III	MED	16	15	MEOH	3.5	TBA	0.2
47	60	I	MED	16	15	MEOH	3.5	TBA	0.2
47	47	II	MED	16	15	MEOH	3.5	TBA	0.2
47	80	III	MED	16	15	MEOH	3.5	TBA	0.2
48	48	I	MED	16	15	MEOH	3.5	TBA	0.2
48	34	II	MED	16	15	MEOH	3.5	TBA	0.2
48	58	III	MED	16	15	MEOH	3.5	TBA	0.2
49	27	I	MED	16	15	MEOH	3.5	TBA	0.2
49	14	II	MED	16	15	MEOH	3.5	TBA	0.2
49	16	III	MED	16	15	MEOH	3.5	TBA	0.2
50	42	I	MED	16	15	MEOH	3.5	TBA	0.2
50	70	II	MED	16	15	MEOH	3.5	TBA	0.2
50	52	III	MED	16	15	MEOH	3.5	TBA	0.2
51	200	I	MED	16	15	MEOH	3.5	TBA	0.2
51	232	II	MED	16	15	MEOH	3.5	TBA	0.2
51	218	III	MED	16	15	MEOH	3.5	TBA	0.2
52	63	I	MED	16	15	MEOH	3.5	TBA	0.2
52	138	II	MED	16	15	MEOH	3.5	TBA	0.2
52	166	III	MED	16	15	MEOH	3.5	TBA	0.2

SUBPROGRAM C

CAR NO	TOTAL WEIGHTED DEMERITS	REPLI-CATE	VOLA-TILITY	FUEL NO	FUEL ID	ALCOHOL	PERCENT OXYGEN	COSOL-VENT	COSOL-VENT RATIO
41	13	I	MED	20	19	MEOH	3.5	ETOH	0.5
41	0	II	MED	20	19	MEOH	3.5	ETOH	0.5
42	6	I	MED	20	19	MEOH	3.5	ETOH	0.5
42	1	II	MED	20	19	MEOH	3.5	ETOH	0.5
43	46	I	MED	20	19	MEOH	3.5	ETOH	0.5
43	36	II	MED	20	19	MEOH	3.5	ETOH	0.5
44	32	I	MED	20	19	MEOH	3.5	ETOH	0.5
44	46	II	MED	20	19	MEOH	3.5	ETOH	0.5
45	1	I	MED	20	19	MEOH	3.5	ETOH	0.5
45	0	II	MED	20	19	MEOH	3.5	ETOH	0.5
46	72	I	MED	20	19	MEOH	3.5	ETOH	0.5
46	53	II	MED	20	19	MEOH	3.5	ETOH	0.5
47	52	I	MED	20	19	MEOH	3.5	ETOH	0.5
47	51	II	MED	20	19	MEOH	3.5	ETOH	0.5
48	40	I	MED	20	19	MEOH	3.5	ETOH	0.5
48	30	II	MED	20	19	MEOH	3.5	ETOH	0.5
49	9	I	MED	20	19	MEOH	3.5	ETOH	0.5
49	16	II	MED	20	19	MEOH	3.5	ETOH	0.5
50	75	I	MED	20	19	MEOH	3.5	ETOH	0.5
50	60	II	MED	20	19	MEOH	3.5	ETOH	0.5
51	238	I	MED	20	19	MEOH	3.5	ETOH	0.5
51	357	II	MED	20	19	MEOH	3.5	ETOH	0.5
52	118	I	MED	20	19	MEOH	3.5	ETOH	0.5
52	178	II	MED	20	19	MEOH	3.5	ETOH	0.5
41	17	I	MED	22	21	MEOH	3.5	ETOH	0.2
41	1	II	MED	22	21	MEOH	3.5	ETOH	0.2
42	3	I	MED	22	21	MEOH	3.5	ETOH	0.2
42	3	II	MED	22	21	MEOH	3.5	ETOH	0.2
43	40	I	MED	22	21	MEOH	3.5	ETOH	0.2
43	31	II	MED	22	21	MEOH	3.5	ETOH	0.2
44	46	I	MED	22	21	MEOH	3.5	ETOH	0.2
44	38	II	MED	22	21	MEOH	3.5	ETOH	0.2
45	0	I	MED	22	21	MEOH	3.5	ETOH	0.2
45	0	II	MED	22	21	MEOH	3.5	ETOH	0.2
46	70	I	MED	22	21	MEOH	3.5	ETOH	0.2
46	63	II	MED	22	21	MEOH	3.5	ETOH	0.2
47	27	I	MED	22	21	MEOH	3.5	ETOH	0.2
47	27	II	MED	22	21	MEOH	3.5	ETOH	0.2
48	40	I	MED	22	21	MEOH	3.5	ETOH	0.2
48	36	II	MED	22	21	MEOH	3.5	ETOH	0.2
49	47	I	MED	22	21	MEOH	3.5	ETOH	0.2
49	4	II	MED	22	21	MEOH	3.5	ETOH	0.2
50	55	I	MED	22	21	MEOH	3.5	ETOH	0.2
50	63	II	MED	22	21	MEOH	3.5	ETOH	0.2
51	253	I	MED	22	21	MEOH	3.5	ETOH	0.2
51	312	II	MED	22	21	MEOH	3.5	ETOH	0.2
52	48	I	MED	22	21	MEOH	3.5	ETOH	0.2
52	154	II	MED	22	21	MEOH	3.5	ETOH	0.2

APPENDIX F

CLASSIFICATION OF TOTAL WEIGHTED DEMERITS

BY TEST MANEUVERS AND MALFUNCTION

TABLE F-I

MALFUNCTION TYPE TWD - SUBPROGRAM A VEHICLES

Fuel	Volatility	Hes.	Stm.	Surge	Back Fire	Stall Accel.	Stall Decel.	Idle	Start Time	Start Stalls	Total
Hydrocarbon	Low	734	140	32	36	320	64	168	68	80	1642
3.5w% MeOH	Low	1062	258	140	36	544	96	212	74	96	2518
7.0w% MeOH	Low	1710	426	296	132	928	96	226	188	96	4098
3.5w% EtOH	Low	1032	144	126	78	416	64	201	66	80	2207
7.0w% EtOH	Low	1152	240	188	96	480	96	193	49	80	2574
Hydrocarbon	Med.	258	18	84	54	64	0	144	90	32	744
3.5w% MeOH	Med.	582	84	92	36	128	96	173	32	16	1239
7.0w% MeOH	Med.	678	66	172	54	224	0	180	9	0	1383
3.5w% EtOH	Med.	426	78	92	96	96	32	167	30	32	1049
7.0w% EtOH	Med.	678	66	172	54	224	0	180	9	0	1383

PERCENT

Fuel	Volatility	Hes.	Stm.	Surge	Back Fire	Stall Accel.	Stall Decel.	Idle	Start Time	Start Stalls
Hydrocarbon	Low	44.7	8.5	1.9	2.2	19.5	3.9	10.2	4.1	4.7
3.5w% MeOH	Low	42.2	10.2	5.6	1.4	21.6	3.8	8.4	2.9	3.8
7.0w% MeOH	Low	41.7	10.4	7.2	3.2	22.6	2.3	5.5	4.6	2.3
3.5w% EtOH	Low	46.8	6.5	5.7	3.5	18.8	2.9	9.1	3.0	3.6
7.0w% EtOH	Low	44.8	9.3	7.3	3.7	18.6	3.7	7.5	1.9	3.1
Hydrocarbon	Med.	31.7	2.4	11.3	7.3	8.6	0	19.4	12.1	4.3
3.5w% MeOH	Med.	47.0	6.8	7.4	2.9	10.3	7.7	14.0	2.6	1.3
7.0w% MeOH	Med.	49.0	4.8	12.4	3.9	16.2	0	13.0	0.7	0
3.5w% EtOH	Med.	40.6	7.4	8.8	9.1	9.1	3.1	15.9	2.9	3.1
7.0w% EtOH	Med.	49.0	4.8	12.4	3.9	16.2	0	13.0	0.7	0

TABLE F-III

MALFUNCTION TYPE TWD - SUBPROGRAM C VEHICLES

Fuel	Volatility	Hes.	Stm.	Surge	Back Fire	Stall Accel.	Stall Decel.	Idle	Start Time	Start Stalls	Total
Hydrocarbon	Low	816	264	68	12	160	64	155	27	56	1622
3.5 MeOH 1:1 GTBA	Low	1272	288	120	90	800	160	174	57	72	3033
3.5 MeOH 4:1 GTBA	Low	1338	330	228	60	800	384	186	52	48	3426
3.5 MeOH 1:1 EtOH	Low	1266	516	164	114	800	224	185	86	64	3419
3.5 MeOH 4:1 EtOH	Low	1524	150	192	138	768	224	171	52	80	3299
Hydrocarbon	Med.	522	310	76	24	96	0	140	20	0	1188
3.5 MeOH 1:1 GTBA	Med.	945	334	80	30	192	0	169	17	0	1767
3.5 MeOH 4:1 GTBA	Med.	906	200	152	42	192	0	176	19	0	1687
3.5 MeOH 1:1 EtOH	Med.	816	414	112	24	224	0	175	17	0	1782
3.5 MeOH 4:1 EtOH	Med.	845	282	144	36	192	0	149	7	0	1655
------------------- PERCENT -------------------											
Hydrocarbon	Low	50.3	16.3	4.2	.7	9.9	3.9	9.6	1.7	3.5	
3.5 MeOH 1:1 GTBA	Low	41.9	9.5	4.0	3.0	26.4	5.3	5.7	1.9	2.4	
3.5 MeOH 4:1 GTBA	Low	39.1	9.6	6.7	1.8	23.4	11.2	5.4	1.5	1.4	
3.5 MeOH 1:1 EtOH	Low	37.0	15.1	4.8	3.3	23.4	6.7	5.4	2.5	1.9	
3.5 MeOH 4:1 EtOH	Low	46.2	4.5	5.8	4.2	23.3	6.8	5.2	1.6	2.4	
Hydrocarbon	Med.	43.9	26.1	6.4	2.0	8.1	0	11.8	1.7	0	
3.5 MeOH 1:1 GTBA	Med.	53.5	18.9	4.5	1.7	10.9	0	9.6	1.0	0	
3.5 MeOH 4:1 GTBA	Med.	53.7	11.9	9.0	2.5	11.4	0	10.4	1.1	0	
3.5 MeOH 1:1 EtOH	Med.	45.8	23.2	6.3	1.3	12.6	0	9.8	1.0	0	
3.5 MeOH 4:1 EtOH	Med.	51.1	17.0	8.7	2.2	11.6	0	9.0	.4	0	

TABLE F-V

MALFUNCTION MANEUVER - SUBPROGRAM B VEHICLES

		TWD								
Fuel	Volatility	Start	0-25	25	25-35	0-35	10-25	0-45	Idle	Total
Hydrocarbon	Low	148	144	0	122	970	236	36	130	1786
3.5 MeOH 1:1 GTBA	Low	201	228	0	320	1332	348	74	186	2689
7.0 MeOH 1:1 GTBA	Low	184	394	8	320	1700	574	162	194	3536
3.5 MeOH 4:1 GTBA	Low	171	270	4	190	1310	214	134	139	2432
7.0 MeOH 4:1 GTBA	Low	181	316	30	254	1676	320	108	162	3047
Hydrocarbon	Med.	111	88	6	58	552	90	34	121	1060
3.5 MeOH 1:1 GTBA	Med.	122	74	6	108	726	228	112	128	1504
7.0 MeOH 1:1 GTBA	Med.	48	122	6	114	800	308	88	160	1646
3.5 MeOH 4:1 GTBA	Med.	85	102	0	72	830	272	40	167	1568
7.0 MeOH 4:1 GTBA	Med.	61	114	6	190	778	164	68	145	1526
PERCENT										
Hydrocarbon	Low	8.3	8.1	0	6.8	54.3	13.2	2.0	7.3	
3.5 MeOH 1:1 GTBA	Low	7.5	8.5	0	11.9	49.5	12.9	2.8	6.9	
7.0 MeOH 1:1 GTBA	Low	5.2	11.1	0.2	9.0	48.1	16.2	4.6	5.5	
3.5 MeOH 4:1 GTBA	Low	7.0	11.1	0.2	7.8	53.9	8.8	5.5	5.7	
7.0 MeOH 4:1 GTBA	Low	5.9	10.4	1.0	8.3	55.0	10.5	3.5	5.3	
Hydrocarbon	Med.	10.5	8.3	0.6	5.5	52.1	8.5	3.2	11.4	
3.5 MeOH 1:1 GTBA	Med.	8.1	4.9	0.4	7.2	48.3	15.2	7.4	8.5	
7.0 MeOH 1:1 GTBA	Med.	2.9	7.4	0.4	6.9	48.6	18.7	5.3	9.7	
3.5 MeOH 4:1 GTBA	Med.	5.4	6.5	0	4.6	52.9	17.3	2.6	10.7	
7.0 MeOH 4:1 GTBA	Med.	4.0	7.5	0.4	12.5	51.0	10.7	4.5	9.5	

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